ILLUMINATING ENGINEER

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What I think about the Bureau—2

Photo by Lafayette

Mr. Howard Robertson, F.R.I.B.A. of Messrs. Stanley Hall, Easton & Robertson

"As an architect," says Mr. Howard Robertson, F.R.I.B.A., "I find the Lighting Service Bureau extremely useful as a liaison between my own profession and that of the lighting engineer."

"Too often in the past there has been a mutual mistrust, based very largely I think, on ignorance of the other man's problems and requirements. The architect, for example, has postponed calling in the electrical contractors until his building has been practically completed; the engineer, on the other hand, has concerned himself simply with the provision of so many foot-candles. The functions of architect and lighting engineer can no longer be divided into such watertight compartments, for light is becoming more and more an integral part of the design of a building. I believe that the Lighting Service Bureau, by its employment of a qualified architect, by its publications containing useful data on lighting and examples of its application, by its lectures and demonstrations and, above all, by its constant efforts to bring the architect and the engineer together to exchange professional experience, is performing a function which my profession welcomes wholeheartedly.

The Conferences for Architects inaugurated last March at the Bureau, and repeated so successfully this spring, indicate a healthy desire for co-operation which is one of the happiest trends of intelligently conducted industry to-day."

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THE JOURNAL OF GOOD LIGHTING
LIGHT LAMPS FITTINGS AND ILLUMINATION
OIL GAS ELECTRICITY ACETYLENE PETROL-AIR GAS ETC.
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The Lighting of Hospitals

THE lighting of hospitals, which was ably discussed in Mr. Raphael's paper on April 13th, is a subject that was last dealt with by the Illuminating Engineering Society rather more than ten years ago. Mr. J. Darch, who read a paper on that occasion,* quoted the observation of Miss Florence Nightingale that "the very first requirement in a hospital is that it should do the sick no harm." He illustrated this remark by striking examples of glare then prevalent in hospital wards. Conditions are probably much better to-day, though it is to be feared that unscreened lamps, annoying to the eyes of patients, are still not unknown.

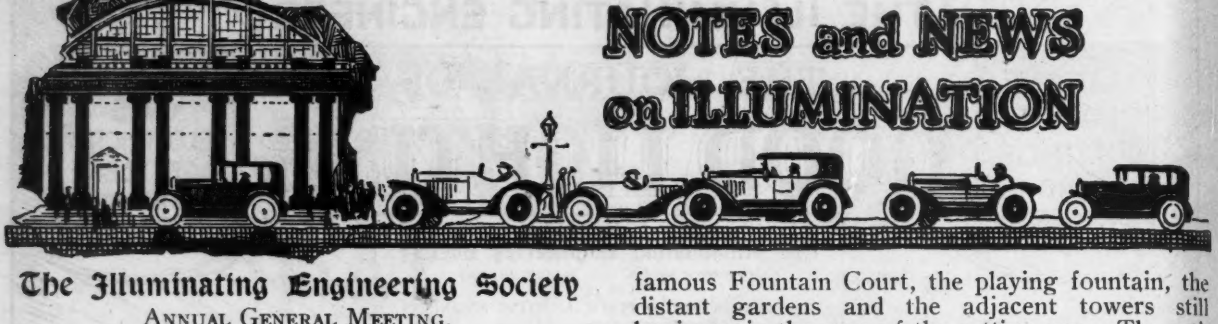
Avoidance of trouble of this kind, arising through the misuse of light, should not be difficult. It is the more desirable because it occasions waste and, as Mr. Raphael points out, there is no margin for waste in a hospital, but every need for economy. A hospital, which probably depends mainly on voluntary contributions and has many claims on its funds, must consider very carefully every item of expense. Economy, however, is a phrase that should be intelligently interpreted. It would be folly to grudge the provision of light essential for a vital purpose—for example on the operating table. But in the wards occupied by the sick, subdued lighting is natural and proper, and the lighting equipment should be as simple and inexpensive as possible; anything elaborate or ornate, which tends to harbour dust (that bugbear of the hospital), must be eliminated.

The paper and the ensuing discussion turned mainly on the lighting of wards and operating tables. Mr. Raphael's method of lighting wards involves the use of simple but especially designed fittings mounted down the centre gangway, which give subdued lighting and an average illumination of 1.8 foot-candles. An interesting point made by the author is that this relatively low illumination can give quite a cheerful effect, because of the very fact that the lighting is uneven; whereas, if this value were maintained uniformly the effect would be flat and depressing. No doubt a hospital ward differs radically from a factory workroom in that strong light is only needed at certain points, for example, over the nurse's table, and this can readily be provided. Specially designed local units and floor standards are available to furnish light for examinations and dressings.

Regarding the lighting of operating tables it would seem that the merits of lamps of the so-called "shadowless" type, first developed by Prof. Verlain, are generally accepted. The high illuminations furnished by such equipment, and the very soft shadows (they are of course not strictly "shadowless") are invaluable. Criticism was directed against the principle of having more or less elaborate lighting fittings mounted overhead, on the ground that they are apt to harbour dust, which may possibly become detached and fall on the operating table. Some have suggested that the alternative method of distributing reflectors round the room, so that their beams play upon the table, the space above the table being thus left free, is preferable. We do doubt, however, whether quite such good lighting conditions could possibly be obtained in this way. There must always be *some* surface which it is necessary to maintain dust-free, if only the ceiling, above the table. The chief lesson would seem to be that the design of the lighting equipment should be very carefully studied in relation to this special problem, i.e., that the lamp should be if possible completely enclosed and that the outer surfaces should be all smooth and polished so that they can be kept scrupulously clean. Two further conditions, not yet completely satisfied, are (1) that the whole equipment should be capable of being easily lowered and removed to one side for cleaning, or at least should be readily accessible for this purpose and (2) that some form of emergency lighting system is desirable, so as to exclude the possibility of the surgeon being left without light in the middle of an operation. The author also mentioned one other point—the desirability of supplementing the special operating lamp by general diffused lighting in the theatre.

Mr. Raphael also touched briefly on that highly interesting device the scialoscope, which enables an image of what is being done on the hospital table to be projected into an adjacent room for the benefit of students. There were many other special problems such as the lighting of dental departments, the construction of x-ray viewing lanterns, and the use of light generally in the treatment of disease which were naturally outside the scope of the paper. Enough was said, however, to show what an important part light plays in the care of the sick. We should like to pay a special tribute to the care taken by Mr. Raphael in the preparation of his very practical paper, and especially in furnishing a number of very effective illustrations.

* *Illum. Eng.*, June, 1922, p. 165.



The Illuminating Engineering Society

ANNUAL GENERAL MEETING.

As already announced, the Annual General Meeting of the Illuminating Engineering Society is to be held in the Lecture Theatre of the Institution of Mechanical Engineers (Storey's Gate, St. James's Park, London), at 6-30 p.m., on Tuesday, May 9th. After the usual initial period for light refreshments, the Report of the Council and the Accounts for the past year will be presented and formal business transacted. Subsequently there will be a discussion on "The Principles of Directive Street Lighting." The original author has unfortunately found himself unable to deliver the proposed paper, but the President has kindly undertaken to introduce the subject.

In accordance with the usual practice when street lighting is being considered, it is proposed to make this a joint meeting with the Association of Public Lighting Engineers. All members of the Association will receive a card giving particulars of the meeting, and it is hoped that a number will be able to be present and take part in the discussion.

Floodlighting on the Embankment

We noticed some weeks ago a suggestion that the County Hall—a building that by reason of its position and fine terrace lends itself well to floodlighting—should be illuminated at night, and that the terrace lights of the Palace of Westminster might also be turned on for the benefit of visitors to London, at least while the House of Commons is sitting. In the meantime London has had a potent addition to its floodlighting in the illuminated Shell-Mex tower, which even now comes as a surprise when glimpsed from certain aspects. Anyone returning to London after a few years' absence abroad, and taking up a position on Westminster or Hungerford Bridge, could not fail to be struck by the changed aspect of the northern shore of the Thames. The light-stoned modern buildings on the Embankment make excellent subjects for floodlighting, and illumination of the whole series from Lambeth Bridge to Blackfriars would produce a night-view comparable with those in any cities abroad. To our mind, these new structures are far from unimpressive. They "build-up" admirably, and have a natural beauty of their own, once one has become accustomed to the flat roofs—which, however, are possibly designed in anticipation of an extension of the building height in the future. Certainly an upward trend in the height of buildings would enhance the possibilities of natural floodlighting from the setting sun, of which we have had some pleasing examples during the recent spell of fine weather.

Lights in The Temple

When passing through The Temple in the dusk our attention was recently drawn to a little bit of public lighting that is not generally known nor sufficiently appreciated—the pleasing antique lanterns, panelled in diffusing glass and housing a cluster of inverted gas mantles, which shed a mild radiance in these courts. We had been admiring the famous Fountain Court, the playing fountain, the distant gardens and the adjacent towers still luminous in the rays of the setting sun. The artificial lighting fitted in admirably with the scene, and the effect is hardly less pleasing when complete darkness has fallen. Whilst these lanterns are possibly open to objection from the standpoint of efficiency, one could not but feel that any such drawbacks were more than compensated by the absence of glare and comfort of vision. We believe that the lighting of many of our thoroughfares would gain vastly if a little light was sacrificed and the filaments or mantles mercifully screened from view.

A Plastics Industry Exhibition

We understand that for some years there has been a tendency for the number of visitors to the Science Museum, South Kensington, to increase progressively—much more so in fact than at the older-established museums devoted to the Arts. Certainly the Science Museum shows enterprise that deserves recognition. In our last issue we referred to the display of photo-electric equipment opened on March 25th. Another display, in its way equally interesting, is the Plastics Industrial Exhibition opened by Lord Irwin on April 5th. This event is due to the joint efforts of the Society of Chemical Industry and the British Plastic Moulding Trade Association. It occupies 10,000 square feet of floor area and reveals an astonishing variety of objects to which these three processes can be applied. It is stated that nearly all of the 75 new industries which have sprung up since the war, based on the use of these synthetic materials, are represented. A series of lectures dealing with plastics, the first of which was delivered by Mr. H. V. Potter (Chairman of the Plastics Group of the Society of Chemical Industry) on April 12th, has been arranged. The final lecture on June 26th is by Mr. K. G. Maxwell, who will deal with the use of plastics in the electrical industry.

The Luminous Efficiency of Rays Entering the Eye Pupil at Different Points

A contribution to the *Proceedings* of the Royal Society by Dr. W. S. Styles and Mr. B. H. Crawford summarizes some investigations on the above subject, which were carried out under the auspices of the Illumination Research Committee of the Department of Scientific and Industrial Research. It is apt to be assumed that the apparent brightness of an object is proportional to the pupil area, though in fact, as the authors show, this is far from being the case. Graphs show a very marked and progressive diminution in efficiency on either side of the optimum point. The causes are not analysed in detail, though doubtless both the varying absorption of the eye-lens and the distribution of sensitiveness over the retina play a part. Presumably, too, the curves obtained at very weak illuminations would depart widely from those determined at normal brightness. The research certainly confirms one point—the inexpediency of basing photometric calculations on observations of the area of the pupil and the deduced relative amount of light entering the eye.

TECHNICAL SECTION

COMPRISING

Transactions of The Illuminating Engineering Society and Special Articles

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

Hospital Lighting

(Proceedings at the meeting of the Illuminating Engineering Society, held in the Lecture Theatre of the Institution of Mechanical Engineers, at 6-30 p.m., on Tuesday, April 11th, 1933.)

A MEETING of the Illuminating Engineering Society took place in the Lecture Hall of the Institution of Mechanical Engineers on Tuesday, April 11th. Members assembled for light refreshments at 6-30 p.m., and the chair was taken by the President (Lt.-Commander Haydn T. Harrison) at 7 p.m.

The minutes of the last meeting having been taken as read, the HON. SECRETARY read out the names of applicants for membership, which were as follows: —

Corporate Member :—

Atkinson, A. C. .....Manager of Showroom and Wiring Department of the City of London Electric Lighting Co. Ltd., 33, Ludgate Hill, London, E.C.4.

Country Member :—

Wilsdon, John .....Electrical Engineer, Messrs. Hill & Upton Co., 4, Richmond Road, Oxford.

The names of those announced at the last meeting of the Society were read again, and these gentlemen were formally declared members of the Society.*

The PRESIDENT then called upon Mr. F. CHARLES RAPHAEL (Consulting Electrical Engineer to St. Bartholomew's Hospital) to read his paper on "Hospital Lighting." The author commenced by pointing out one respect in which the lighting of hospitals differs from many other problems, namely, the necessity for very careful consideration of cost and avoidance of waste. Subsequently the main characteristics of hospital lighting were explained, and the special problems involved in the lighting of wards and operating theatres discussed with the aid of numerous effective lantern slides.

At the request of Mr. HAYES, the Secretary of St. Bartholomew's Hospital (who was called upon to open the discussion), Miss C. K. HAYES, the superintendent of the theatres, made a few remarks, after which contributions were made by Mr. C. M. POWER, Mr. HAROLD BRIGHT, Mr. E. STROUD, Mr. H. C. WHEAT, Mr. H. E. MATHEWS, Mr. J. S. DOW, Mr. G. DAVIDSON, Mr. E. M. JOHNSTON and Mr. E. LUDGATE. The PRESIDENT, after winding-up the discussion, called upon Mr. Raphael to reply to the various points raised, after which a cordial vote of thanks was accorded to him for his interesting paper.

In conclusion, the HON. SECRETARY announced that the Annual General Meeting would take place at 6-30 p.m. on May 9th, when, after the presentation of the Annual Report of the Council for the past session, a discussion on "Principles of Directive Street Lighting" would be opened by the PRESIDENT.

* *Illum. Eng.*, April, 1933, p. 91.

Programme for Forthcoming Session (1933-1934).

Preparations for the next session, which occurs in the twenty-fifth year of existence of the Society, are now being made.

We have been asked to impress upon members the need for their personal co-operation in offering suitable papers—either paper furnishing material for a full evening's discussion, or shorter contributions on special topics, such as those habitually included in the material for the "problems" meeting.

It will be recalled that the Leon Gaster Premium of £10 10s., which is granted annually for the best contribution on any aspect of illumination presented to the Society, has already been awarded in two successive years. This, it is hoped, will furnish an additional incentive to effort.

Papers of an original character embodying the results of research are specially desired, but contributions of a statistical and descriptive nature will also be welcome.

We are also requested to mention that the List of Members, printed copies of which were issued last year, is about to undergo revision. Reply postcards, enabling members to inform the Hon. Secretary of names and addresses, have been issued to all members, who are asked to lodge information of any changes of address not later than June 30th.

National Safety Congress

The 1933 National Safety Congress will take place in London during May 24th-26th. Following the official welcome to delegates on the morning of the opening day, there will be discussions on "Remedies for Road Accidents" and "Some Safety Problems of the Road Engineer." Other sessions, arranged jointly with bodies interested, deal with various aspects of industrial safety, and a joint session with the B.E.D.A. is devoted to "Electricity and its Safe Use in Daily Life."

Hospital Lighting

By F. CHARLES RAPHAEL, M.I.E.E.

(*Consulting Electrical Engineer to St. Bartholomew's Hospital*).

(*Paper read at the meeting of the Illuminating Engineering Society, held at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, at 6-30 p.m., on Tuesday, April 11th, 1933.*)

The Need for Economy.

In opening this paper it is advisable that stress should be laid upon one matter that has in recent years tended to fall into the background at the meetings of this Society. It is the question of cost, particularly running cost. Generally, when lighting interiors, we have gradually fallen into the habit of ignoring this to some extent—and rightly. The lighting bill in a factory, for instance, represents a very small proportion of the total overhead charges; even if it were doubled, the additional cost of the articles manufactured in the works would in most cases be only increased by a small fraction of 1 per cent., and this increase would immediately be more than compensated by the speeding-up of production consequent upon the better illumination. In a hospital, however, there is no such direct connection between lighting costs and revenue. To give a higher degree of illumination than is warranted by our actual requirements would be sheer waste. It is only necessary to quote one figure to emphasize this point. The expenditure on electric lighting alone at St. Bartholomew's Hospital, where the author can guarantee that there is no wastage, was over £1,500 during the year 1932.

Ward Lighting.

But in hospital ward lighting it is not merely on account of economy that a low standard of illumination is desirable. The lighting must be restful, and this necessitates a fairly low standard of illumination. On the other hand, it must be cheerful, and this means a definite avoidance of "flatness." The average illumination of the example of good ward lighting which is taken as an illustration in this paper, exclusive of more intense local illumination which is turned on as required, is in the order of 1.8 foot-candles. The author, besides being in constant touch with the hospital staff, was himself a patient in the ward in question for several weeks, and can vouch for the lighting being both cheerful and adequate. A perfectly diffused lighting worked out of this low figure of 1.8 foot-candles would be flat and depressing. It would make everybody—patients, nurses, visitors and medical staff alike—listless and miserable. Large units with suitable reflectors hung at the customary heights and spacings familiar to illuminating engineers would be equally unsuitable. Lamps, shades and reflectors in a hospital ward have to be regularly dusted by hand, and must not be at a greater height than can be reached by a very short pair of steps. The maximum height allowed for lamp shades in a ward is 8 feet, and it is clear that, at this height, high-wattage units are inadmissible owing to glare—in fact, the importance of preventing glare on the eyes of the patients lying in bed would in itself be sufficient to make the use of large units near ceiling level

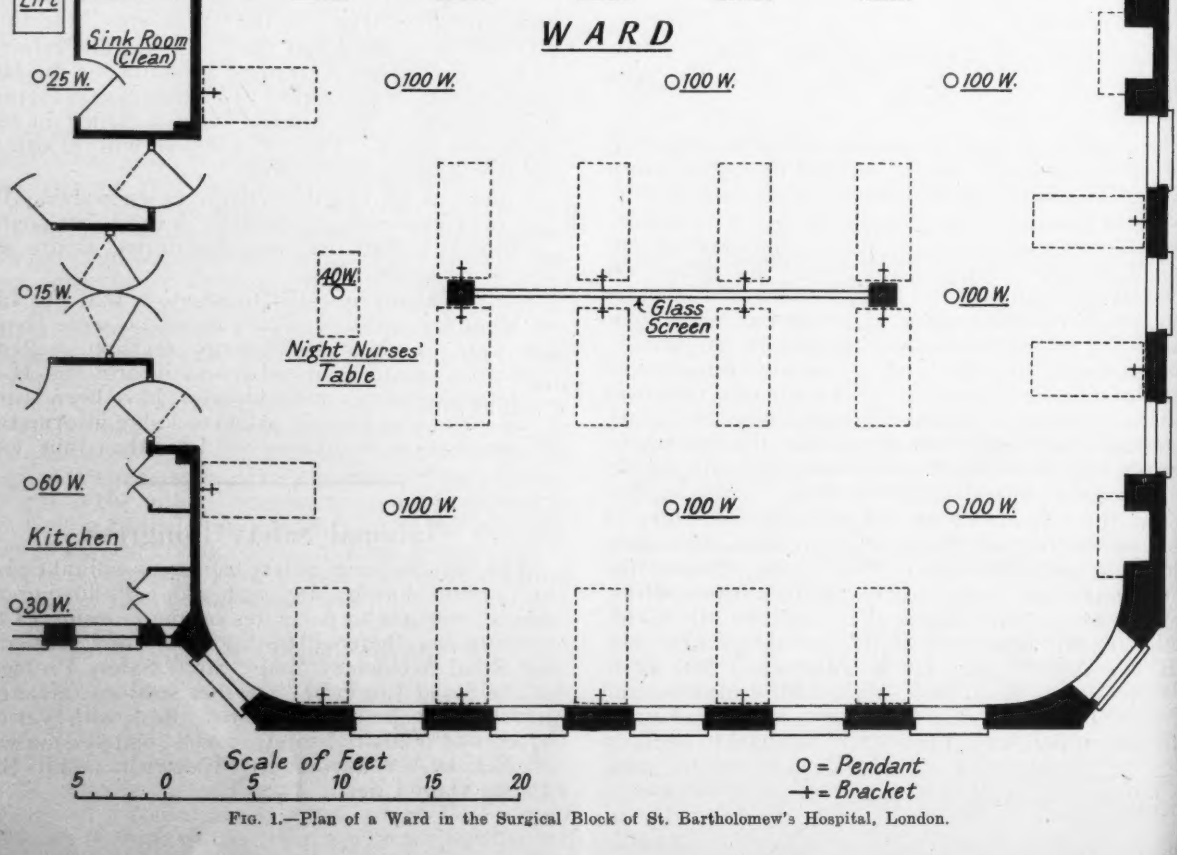


Fig. 1.—Plan of a Ward in the Surgical Block of St. Bartholomew's Hospital, London.

out of the question. The problem is, however, not really a difficult one; it merely means reverting to what will appear to the progressive illuminating engineer as an old-fashioned and out-of-date layout.

Fig. 1 shows the arrangement adopted by the author in the ten new wards at St. Bartholomew's Hospital, completed about three years ago. As seen, the disposition of the beds follows the usual method, and there is a row of pendants over the centre line of the gangway, spaced 16 feet apart (12 feet at the end of the ward for symmetry) and hung at a height of 8 feet. The lamps are 100-watt opal and the shades (Fig. 3) are of satin flint glass.

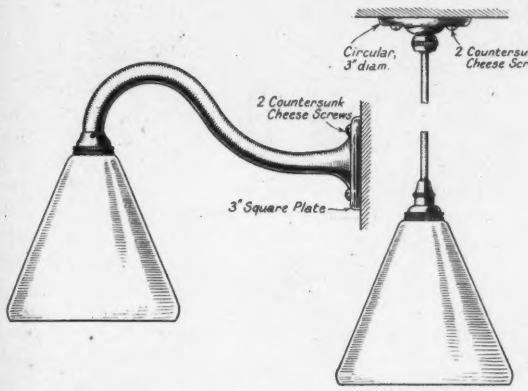


FIG. 2.—Bracket with Hospital Pattern Shade.

FIG. 3.—Pendant with Hospital Pattern Shade.

The shade is one which was specially designed as a useful general-purpose shade for hospital use by the author, to combine the features of being sufficiently intensive for bed-brackets at a low height and sufficiently dispersive for general lighting, obscuring the lamp filament without being too absorbent, and, last but not least, a definite departure from standard lines so that it should be neither ugly nor commonplace. To secure the latter feature, the author has an arrangement with the makers that the supply of these shades is limited to his own clients and excluded from catalogues and retail shops. They have never been subjected to the indignity of being called "illuminating glassware." Fig. 3 also shows the ceiling plate used for the pendant. The ceiling plate is screwed directly into the conduit box sunk in the ceiling, without any wood block or ceiling rose.

The 40-watt lamp seen at the near end of the ward is above the night nurse's table, and is a traditional feature of all hospital wards. It is in a deep green and white opal shade, and is an exceptionally long counterweight pendant which is pulled right down close to the top of the table at night, when it is the only means of illuminating the ward.

Some photometric measurements have been taken with a lumeter lent me by Mr. H. C. Wheat, whose assistant Mr. W. A. Ives kindly assisted me in the measurements. They were taken with the ward occupied and under normal conditions, between 6 and 7 p.m. early last month, with only the seven 100-watt lamps and the 40-watt end light switched on, the latter being pushed up to the same height as the larger pendants, viz., 8 feet above floor level. The illumination on a horizontal plane immediately below the 100-watt pendants was 6.25 to 7.5 foot-candles, the larger figure being under the lamp at the far end of the ward. Half-way between the lamps the illumination was from 1.3 to 1.6 foot-candles, except at the far end, where it was 3 foot-candles. It should be explained that the somewhat increased light at this end is intentional, as it is regarded as the end of the ward where the patients who are well enough to sit up for an hour in the evening congregate. At the head of the beds, along the sides of the ward, the illumination on a horizontal plane 2 ft. 6in. up was a minimum of 0.8 foot-candles; on a book that a patient was reading in bed it was 1.25 foot-candles, and near the foot of the bed 1.8 foot-candles. Over the nurse's table the illumination was from 1.3 to 40 foot-candles, according to the height of the pendant.

It was not possible to obtain sufficient readings to enable an accurate calculation to be made of the average illumination over the whole area, but this may be estimated at 1.8 foot-candles.

This works out at a utilization factor of about .5. The high figure is accounted for by the small absorption of the flint glass of the shades and the light colour of the walls. They are medium cream in colour, with a fairly matt surface, and appear to the author to be an ideal tone for the purpose. A measurement of the coefficient of reflection was made, and found to be 50 per cent. The medium green, which for a long time was regarded as the correct colour for hospital wards, would have required a considerably bigger wattage, and the author is of opinion that it is not the correct colour for an urban hospital even if daylight illumination only is considered. For a cottage hospital in a country district also it is doubtful whether an imperfect imitation of the patients' natural surroundings is the best thing. At the Hospital of St. John and St. Elizabeth, in St. John's Wood, an almost glossy pale blue is employed, which is even better than the medium cream for artificial lighting, but gives rather a harder light in the daytime. Possibly the question of daylight illumination, which does not come directly within the author's own activities, will be dealt with in the discussion—particularly in connection with operating theatre lighting.

To return to our foot-candles, it is clear that the illumination of about 1.25 foot-candles is not intended as a reading light, and is also insufficient for examinations and dressings. Bracket-lights over each bed are thus essential. When the lighting specification for the wards at St. Bartholomew's Hospital was under consideration there was some discussion as to whether these brackets should not be double, with one lamp for reading and the second for the use of the surgical and nursing staff. It was decided that one light with a good illumination for reading would suffice for general examinations, and that, as a supplement to this, a more easily directive light was preferable to a bracket light, and that this could most conveniently be afforded by a floor standard or a hand lamp.

Fig. 2 shows the plain design of bracket adopted. It is screwed directly to a sunk conduit box in the wall, without a wooden block, and has other features for convenience in wiring and maintenance. It is fitted with a 25-watt Pearl lamp, and increases the illumination immediately in front of the patient's head to 3.7 foot-candles, which falls gradually to 2 foot-candles at the foot of the bed.

The only other fixed light in the ward itself is a shielded lamp in the poison cupboard, with a local switch.

Fig. 4 shows the floor standard which was made to the author's instructions. Its main features are the very large base with big rubber-tyred wheels on ball bearings, and the unusual size of the adjustable universal ball socket to which the lamp and shade are fixed, both for ease of manipulation and adjustment and the reduction in maintenance costs. The top portion can be raised or lowered or rotated, and is clamped without any projecting screw. Fitted with a 25-watt lamp, and adjusted to the normal distance from the patient, it gives a field of illumination

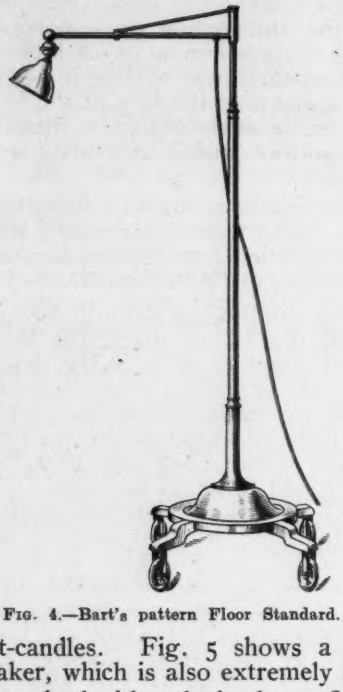


FIG. 4.—Bart's pattern Floor Standard.

of 47 foot-candles. Fig. 5 shows a design by another maker, which is also extremely adjustable.

A floor standard with a shadowless reflector made on the same lines as those for operating-table lighting, but of smaller diameter, was also submitted as an alternative, but was decided to be unnecessary for service in the wards.

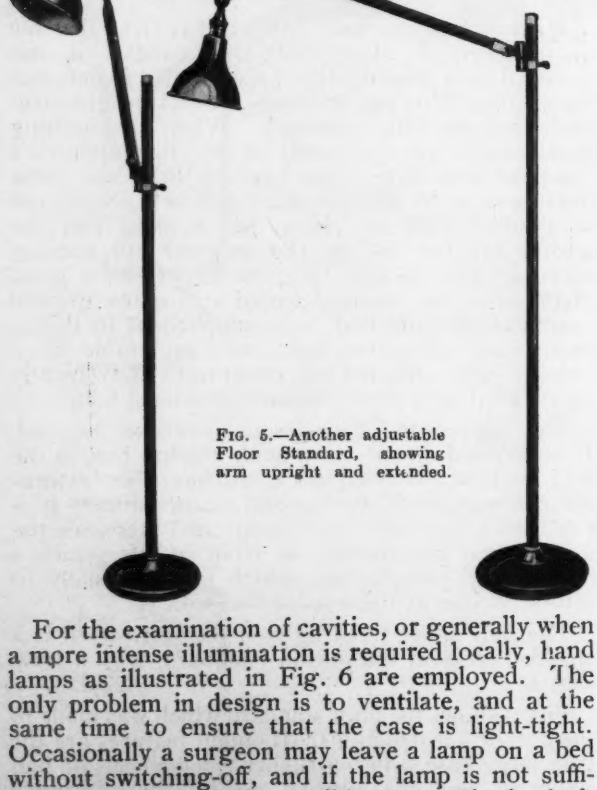


FIG. 5.—Another adjustable Floor Standard, showing arm upright and extended.

For the examination of cavities, or generally when a more intense illumination is required locally, hand lamps as illustrated in Fig. 6 are employed. The only problem in design is to ventilate, and at the same time to ensure that the case is light-tight. Occasionally a surgeon may leave a lamp on a bed without switching-off, and if the lamp is not sufficiently ventilated it is possible to scorch the bedclothes. The bulb is a 15-watt indicator lamp with standard B.C. cap, and with this a local illumination up to over 200 foot-candles is obtainable.

Before leaving ward lighting, the method of dimming may be referred to. The author was instructed to arrange that any ward lights that might be switched on after 8 p.m. should be dim, except the lamp over the night nurse's table and the lamp in the poison cupboard. There are two supplies to the hospital: 200-volt D.C. for most purposes, and A.C. supplied by another company for emergency lighting and various medical and surgical purposes for which D.C. is not applicable. So a step-down trans-

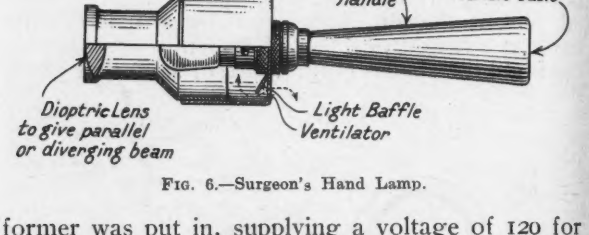


FIG. 6.—Surgeon's Hand Lamp.

former was put in, supplying a voltage of 120 for dimming, and a change-over switch was installed for the sub-circuits in question in each ward. The sister has merely to switch this to "Dim" at 8 p.m., and it is switched back to "Full" when the patients are awakened in the morning. This also meets the requirements for emergency lighting. At night-time the ward is thus lighted from two distinct sources of supply, and the fire-escape stairs are on the D.C., and are therefore at night lighted from a different source from the general ward lighting. In the private wards, in which the more serious cases are dealt with, it was desirable to make the dimming a local matter, as full light might be required at any time of the night. This is effected by the use of a double-filament lamp controlled by a "two-way-and-off" switch. One filament of the lamp is 40-watt and the other about 1-candle power; the lamps have three contact caps and the holders have three plungers. This method has been employed in such wards at the hospital for over 25 years, and is very useful. There has so far been no difficulty in obtaining the lamps, which were originally what may be called a "standard special" type of one manufacture. It is still possible to obtain these lamps for St. Bartholomew's Hospital, but recently there has been difficulty in having them for other voltages. This is a pity, for the lamp would be very popular for hospitals, night nurseries, etc., if it were better known, and the arrangement is a far more practical one than a resistance dimmer which requires ventilation, and is in consequence a nuisance to put in on sunk work unless it is unavoidable.

OPERATING THEATRE LIGHTING.

No large modern hospital operating theatre for major operations would nowadays be deemed to be properly equipped without a shadowless lamp over the operating table. The first attempts in the direction of diminishing shadows were simply to multiply the sources of light. By illuminating the table from several points it was clear that the head and hands of the operating surgeon would not be simultaneously in the direct beam from each. For many years the author found that surgeons were quite satisfied with six lamps placed in two lines of three on either side of the table, in such a way that the field of light from each overlapped. This method was adopted by him even before the Illuminating Engineering Society was born, and the lamps then known as of "door-knob" shape were employed with ordinary flat opal shades above them. The spillage of light was very great, and with tiled walls very little additional illumination was required in the theatre. For small hospitals and in theatres for minor operations similar methods are still largely employed, and there are few nursing homes that can afford truly shadowless lamps in their theatres. Even

in one of the largest nursing homes in London the author observed recently a large fitting (he believes of American design) consisting of a ring of about 20 lamps. Without going to this extreme wattage, the heat from such fittings is troublesome to the surgeons, and the intensity of illumination had to be kept down to a moderate figure in consequence.

One of the first steps in the direction of a cool and virtually shadowless light came from Germany. An arc-lamp was placed outside the theatre, and, by means of a large number of mirrors fixed on the

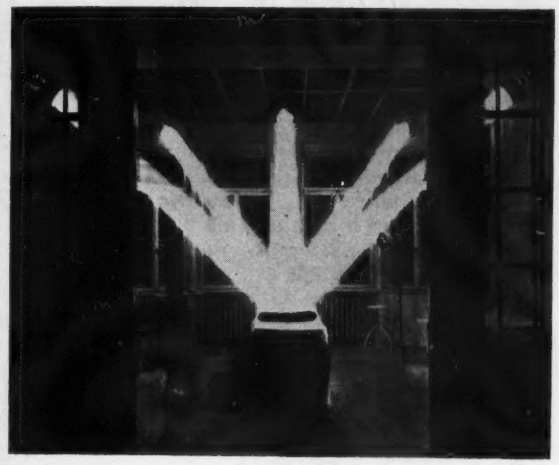


FIG. 7.—Operating Table lighted by reflector ball fittings.

walls, the light was directed from various points on to the operating table. This method was used for some years in one of the theatres at the Middlesex Hospital, but was displaced in 1922 by a scialytic lamp. It still survives in a modified form elsewhere; gasfilled lamps are placed in reflectors at suitable

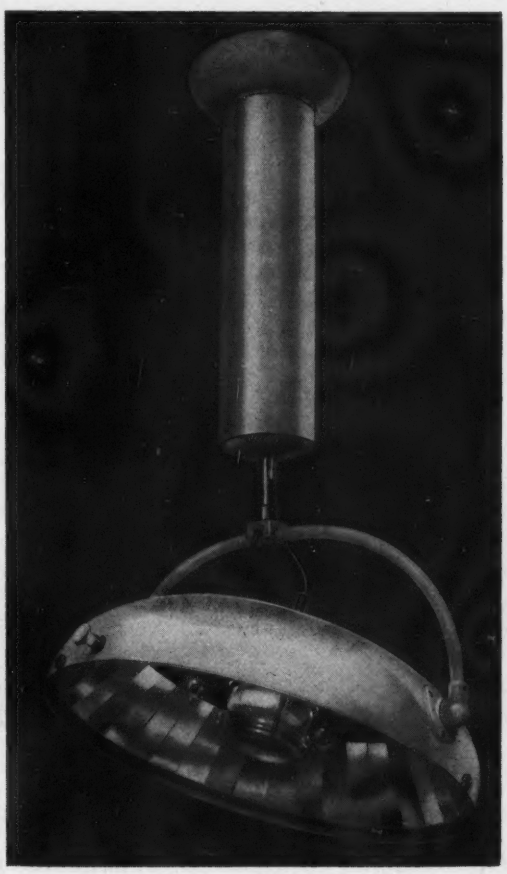


FIG. 8.—Scialytic Lamp with cupola tilted to show dioptric lens and mirrors.

points on the walls, and reflect narrow beams of light on the table (Fig. 7.)

The originator of the present-day shadowless operating theatre lantern was Prof. Verain, and the French lamp known as the " scialytic " was made on the principle introduced by him, and is still probably the most popular.

A 100-watt lamp is placed in the centre of a dioptric lens so that its light is directed horizontally all round. This is in the centre of a large cupola on which a number of narrow plain glass mirrors are built up on a truncated cone. Fig. 8 shows the cupola tilted, and makes the system quite clear. Between the lamp and the dioptric lens there is a cylinder of a heat-absorbing glass. It will be realized that the light is reflected downwards in the form of a hollow inverted cone, Fig. 9, and that, given a large enough diameter for the cupola, the head of the operating surgeon will be in the interior of this hollow cone, while his hands will only obscure a negligible portion of the light. The importance of a large diameter to obtain the best results cannot be over-estimated. In the lamp used for large operating theatres the diameter of the cupola is 890 mm. (about 36 ins.).

A German maker followed on somewhat similar lines to the scialytic, but the lamp has no dioptric lens, the cupola is a concave glass mirror, and there is a small auxiliary mirror to reflect back to the concave mirror the light which radiates obliquely downwards from the filament. The light directed downwards from the main reflector is almost a solid cone, and consequently not quite so shadowless as the scialytic, and a lamp of at least 150 watts is required. A Scottish firm supplies a somewhat similar lamp with a metal reflector, but they omit the auxiliary mirror, so that in addition to the reflected inverted cone of strong light on the table itself there is a circle of direct light of lower power for a few feet on each side of it. Finally, a firm of English manufacturers entered the field with a 36-in. shadowless lamp, using a similar ring of mirrors to the scialytic,

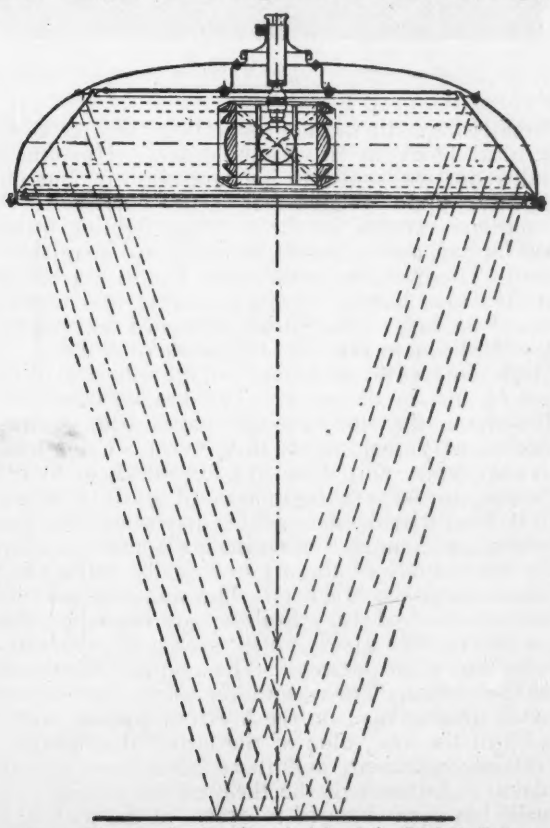


FIG. 9.—Diagram showing the principle of the Scialytic Lamp.

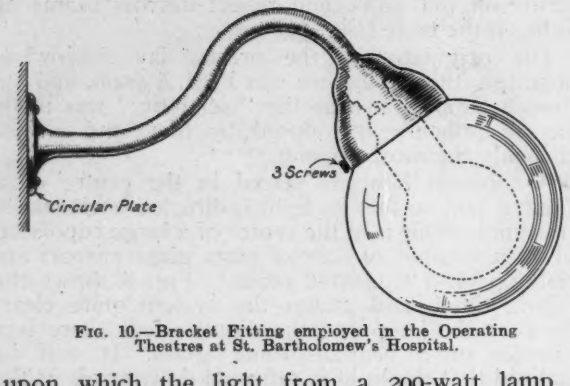


FIG. 10.—Bracket Fitting employed in the Operating Theatres at St. Bartholomew's Hospital.

upon which the light from a 200-watt lamp is reflected; in their smaller pattern the ring of mirrors is replaced by a chromium-plated reflector.

With all these lamps, in which all the light is concentrated on the operating table, it is necessary to illuminate the remainder of the theatre. This is usually done by placing bracket fittings at places where the maximum auxiliary lighting is required, relying on the spillage aided by the reflecting surface of the walls, to produce the necessary general

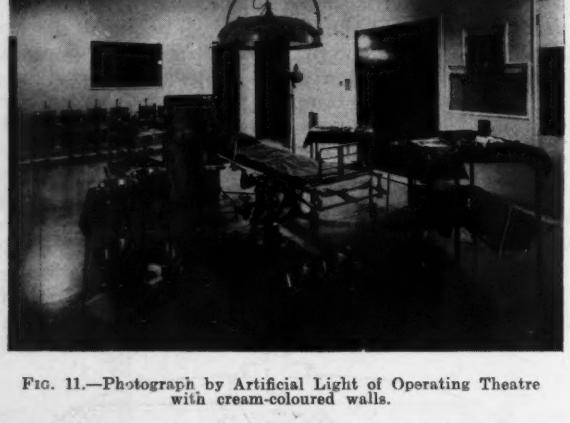


FIG. 11.—Photograph by Artificial Light of Operating Theatre with cream-coloured walls.

illumination. In the five operating theatres of the surgical block at St. Bartholomew's Hospital an endeavour was made to improve slightly, but only slightly, upon this rather crude method. The positions available for the auxiliary lighting fittings was limited, and economy, as usual, was a consideration. There was no alternative but to use bracket fittings at a height at which dusting and washing would be easy. The fitting designed for the purpose is shown in Fig. 10. It is made of monel metal, which requires no polishing, and the spherical globes are 6½ ins. in diameter. The brackets are fixed directly to the sunk conduit boxes without wood blocks, at 7 feet above floor level. Each has a 60-watt lamp, and there are five of them in each theatre, to serve a floor area of 30 ft. 6 ins. by 19 ft. 6in. Inadequate as this may seem, this gives a minimum illumination on the horizontal plane over the whole space of about 1 foot-candle and 2.5 foot-candles near the brackets. The walls are not tiled, but, in two of the theatres, are painted cream coloured with a glossy finish, giving a coefficient of reflection of 71 per cent. The average illumination on the vertical plane was not measured, but is clearly much greater than on the horizontal plane, and, in spite of the low value of the latter, the lighting is certainly sufficient, and there have been no complaints. In three of the theatres the colour of the walls has been changed to green, at the wish of the surgeons who work there.

Figs. 11 and 12 are photographs taken by the light of the brackets only. Exactly similar plates were used and the exposure was identical. They show clearly the lower illumination and poorer distribution and sharpness of outline with green walls. Fig. 13 is another photograph in the room with the cream walls when the lamp over the operating table was switched on as well as the side brackets, and shows how closely the intense illumination on the operating table is localized. Photometric measurements on the operating table with the lamp focussed for ordinary working conditions gave an illumination of about 450 foot-candles. The author then moved his head about in various positions between the lamp and table, and was unable to reduce the illumination to a lower figure than 300 foot-candles.

Returning to the general lighting of the operating theatre which has been described. Theoretically, of course, it is all wrong. We are taught that on looking up from a brightly illuminated surface to a duller one and back again, the eye has constantly to adjust itself, and that the greater difference there is between the illumination of the two surfaces the greater is the eye-fatigue and the less the accuracy

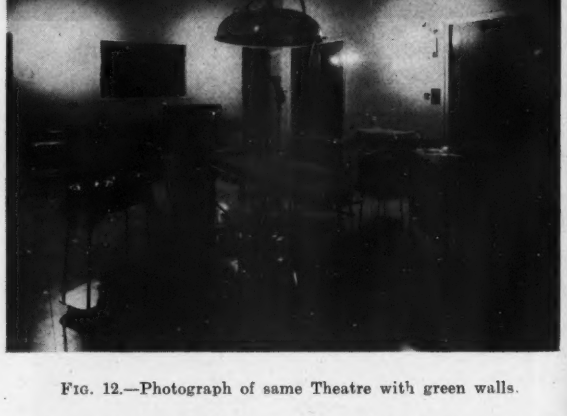


FIG. 12.—Photograph of same Theatre with green walls.

of vision when looking upon the brighter surface. In practice, however, the difference between the brightness of the two surfaces is so great that it is unlikely that there could be any difference in the

FIG. 13.—Photograph of Operating Theatre with Scialytic Lamp switched on.

eye-fatigue whether the walls were 2 foot-candles or 20 foot-candles.

On considering the conditions in bright daylight, when the fitting over the operating table is not in use, it is evident that we may frequently have the

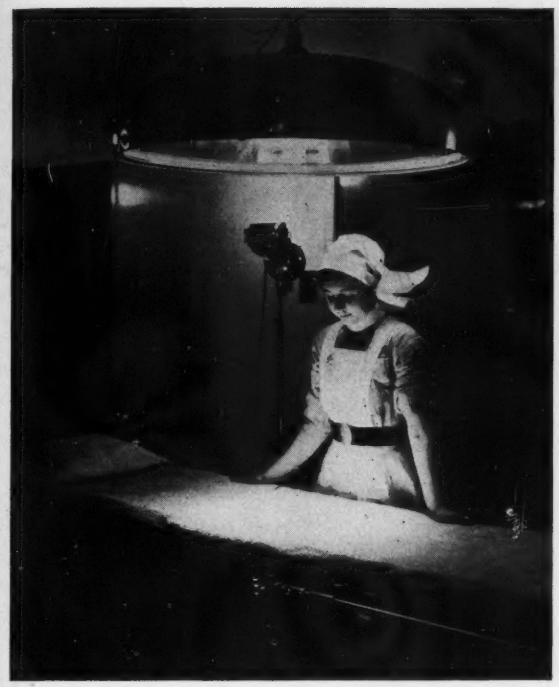


FIG. 14.—Reflection from a White Towel on an Operating Table.

FIG. 15.—Reflection from a Green Towel on an Operating Table.

reverse effect. In operating theatres with white-tiled walls, for instance, the walls by daylight are far better illuminated than the patient on the operating table, and when looking into a cavity this will certainly be less well-lighted than the surface of the walls. Some surgeons complain very much of eye-fatigue at the end of an afternoon's work in such a theatre, and prefer a less-efficient reflecting surface and a more restful colour on the walls than white or cream. The personal equation comes in very largely, as others prefer the brighter walls. The lower illumination of the working plane than that of the walls can, however, be compensated for by using the lantern over the operating table in daylight as well as at night-time, and this is frequently done, and, moreover, a spotlight is always provided for lighting up cavities.

Another disturbing feature also has to be reckoned with, namely, the light reflected back to the surgeon's eyes by the towels surrounding the patient. The use of green towels mitigates this, and is the present practice at St. Bartholomew's Hospital. Figs. 14 and 15 are from untouched photographs taken to illustrate this. The light reflected on to the nurse's face by the white cover on the table is clearly seen in Fig. 14, as is also the disturbing brightness of the white surface of the towel beyond the working field.

Except for eye, ear, throat and nose operations, it is not the custom to darken the theatre when carrying out operations by daylight—and the majority of operations are carried out in daylight hours. Consequently in an ideal theatre it would be advantageous to have available a reasonably high degree of general lighting, particularly on the vertical plane, so that working conditions by artificial light should not be too dissimilar from those in daylight. With green walls, an increase in lumens per square foot may become essential in the theatres illustrated. Pendant fittings—with the exception of the operating lantern—are ruled out owing to inadvisability of increasing the surfaces high above floor level that have to be cleaned, and the number of wall-brackets cannot be greatly increased; in fact it would be better to do away with them altogether. Some form of panel lighting is therefore indicated. It is important that the illuminating surface should not have too high a brilliancy, the resulting illumination should not be too high, and it should be possible to regulate this to some extent by switching without producing a patchy result. Fig. 16 is a sketch which Mr. H. C. Wheat has kindly got out at the author's suggestion, to consider its application to an operating theatre for a provincial hospital. The floor area is about 360 square feet. Lighting panels, it has been assumed, would be placed right round the room, starting at 7 ft. 6 ins. above the floor to enable them to be carried over the doors as well, and there is a perimeter of about 66 feet to cover, which excludes the space occupied by the window. The choice lies between the use of a flashed-opal front panel with the lamps at some distance back, or a reflector system in which the light from the lamps is reflected on to a white back surface and plain glass front panels. The latter method has been selected in the scheme shown, as it requires less wall thickness. With a practically continuous row of tubular lamps at the bottom of the panel, thirty-five 40-watt tubular lamps would be required. Assuming a conservative figure of 220 lumens per lamp and an equally conservative value of 33 per cent. for the utilization factor, the illumination works out to 7 foot-candles. A higher or lower value could, of course, be obtained if required by varying the loading and spacing within limits.

A method combining the lighting on the operating table with the general lighting of the theatre by means of a number of prismatic glass plates, forming a false ceiling with lamps and reflectors above it, was described by Mr. E. Stroud before this Society in 1930,* and he will doubtless be willing, in the course of the discussion, to give us his experience with it in actual practice. He will probably have had to overcome some prejudices against the necessary reduction in the working height of the theatre to accommodate the ceiling units, and he may have met some objections to the high loading and to the necessity of fixing the prismatic plates with their rough surface downwards.

Reference has been made to spot lighting by means of a floor standard. Peculiar as it may seem, the selection of a suitable fitting has given from

* *The Illum. Eng.*, Vol. XXIII, p. 9, January, 1933.

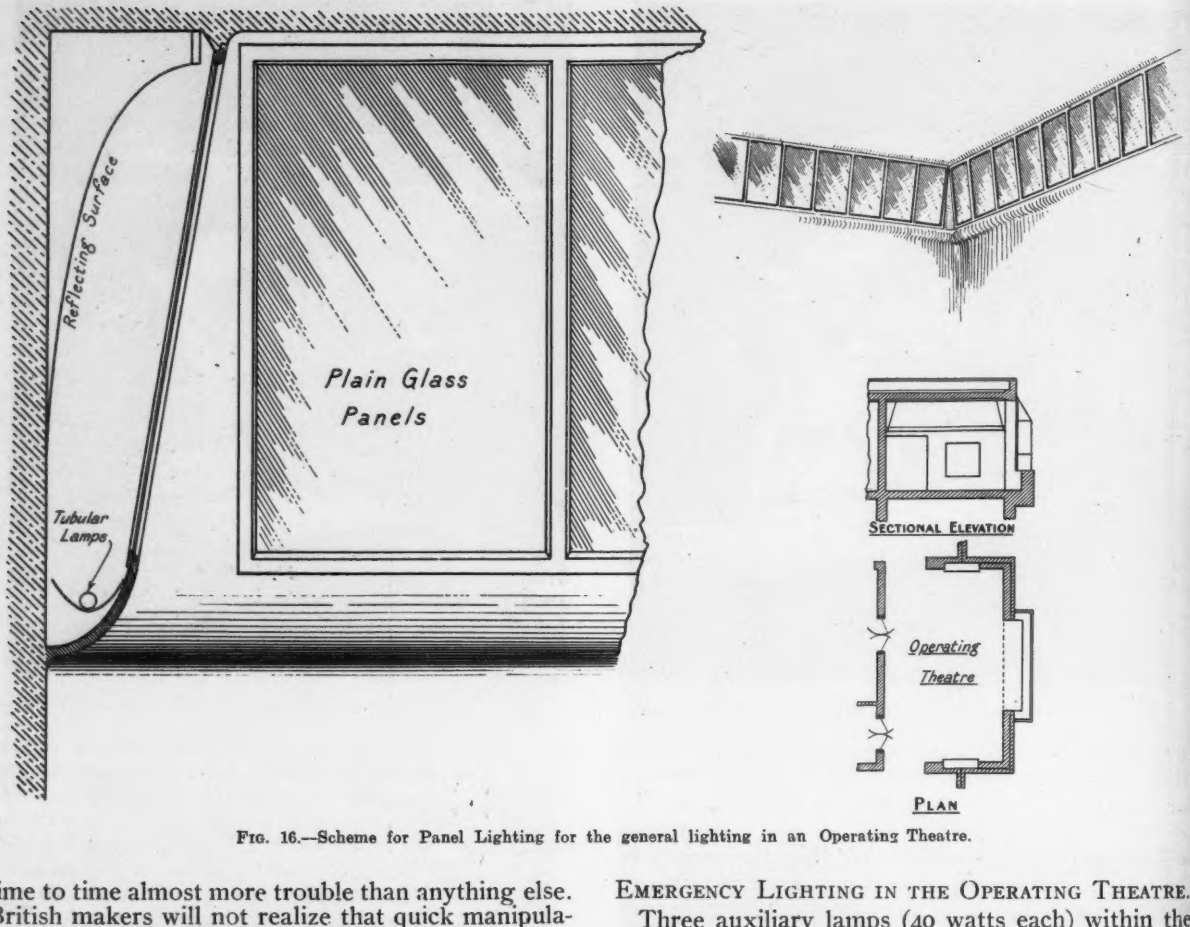


Fig. 16.—Scheme for Panel Lighting for the general lighting in an Operating Theatre.

time to time almost more trouble than anything else. British makers will not realize that quick manipulation and easy and accurate adjustment are of first importance. Owing to this, the lantern preferred by the surgeons is of German make. It gives an almost parallel beam, there is no trouble from filament images, and it is very easy to direct the beam accurately. Its two disadvantages are its high cost, and, a small, but important detail, namely, that it is not made to take the cab-tyre flex and is not designed for the earthing connection which is required in British practice to conform with safety regulations.

A measurement made under normal working conditions showed that, with the field normally used, the illumination of 450 foot-candles was increased to about 600 by the spotlight.

Although the makers have done their best to overcome the difficulty introduced in using a bunched filament lamp in a confined space behind lenses, the author has always regretted that the standard operating theatre spotlight should not be a "Pointolite." This lamp, in which a small tungsten arc burns in an evacuated bulb, was invented by Mr. Mullard, of valve fame. The lamp itself is in every way suitable for a small projector lamp. Although it is used to a certain extent by ear and throat specialists, to whom an intense beam of small diameter is of the utmost utility, it is no longer selected for general operating theatre use, for the reason that no manufacturer has yet produced a sufficiently convenient form of lantern. The mechanical problem of ease in directing the beam of light need present no difficulty; it has already been solved in the German lamp. The electrical problem arising from the fact that the voltage required by the tungsten arc is only 45 could also be dealt with in a far more practical manner than with the present forms of lantern, series resistances and starting devices particularly when a A.C. supply is available.

Emergency Lighting in the Operating Theatre.

Three auxiliary lamps (40 watts each) within the cupola of the shadowless lamps are connected to an independent source of supply to the central lamp. If an independent outside supply is not available, low-voltage lamps are used connected to an accumulator, and it is advantageous to include a relay which switches these in automatically as soon as the main supply fails.

The Scialyscope.

When medical schools are attached to hospitals, the authorities must provide means for the students to be present at the operations. The operating table is surrounded by those who have to assist—surgeons, anæsthetist and nursing staff, so that the students have to see over their heads, and in consequence

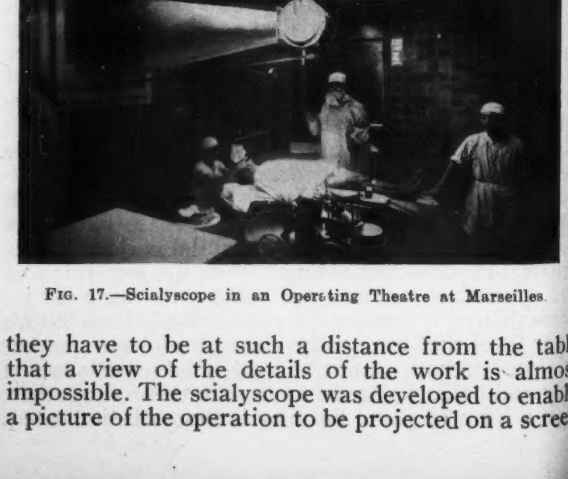


Fig. 17.—Scialyscope in an Operating Theatre at Marseilles.

they have to be at such a distance from the table that a view of the details of the work is almost impossible. The scialyscope was developed to enable a picture of the operation to be projected on a screen

in an adjoining room, to which the operating surgeon's explanation to the students can also be transmitted by means of a microphone and loud speaker.

Above the operating table there is a scialytic lamp on the same principle as has been described already, but of larger size. The diameter of the cupola is about 10 feet, and a 5,000-watt lamp is used inside the dioptric lens. The optical system to project the picture is placed in the unlighted part of the hollow cone of light (Fig. 17), and, by means of the objective lens at the bottom and a system of mirrors and prisms, the image of what is being done is displayed to the students in the next room three times its natural size, and in its actual colours, on a screen one metre in diameter. Fig. 18 shows the students'

FIG. 18.—Students viewing the Picture projected by the Scialyscope.

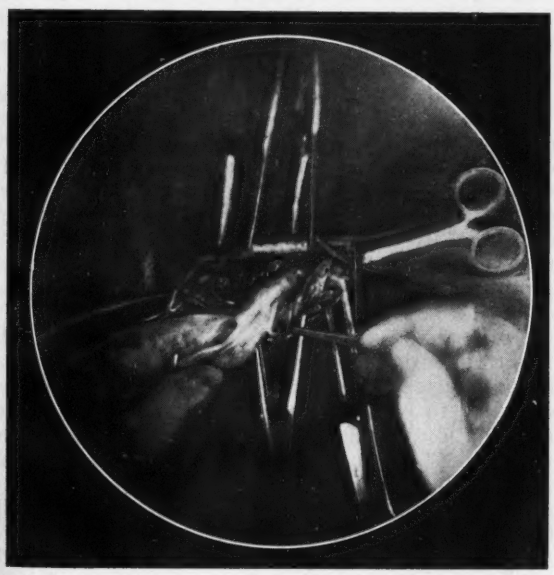


FIG. 19.—Showing the character of the Picture projected.

class; unfortunately the photographer has lighted the room and spoilt the definition on the screen, but Fig. 19 is the kind of picture that is projected.

As this paper is only intended to be introductory to a general discussion on hospital lighting, it has already been inordinately long. It is, therefore, not possible to deal with such matters as surgeon's headlights, the correct lighting of dental departments, the construction of X-ray viewing lanterns, and other requirements for particular purposes which constantly arise in hospital work. Nor has it been possible even to touch on the subject of electric-light treatment. The audience has been very patient in listening to a very elementary survey of the subject, and doubtless they will be rewarded by now hearing a lively, destructive, and it is to be hoped constructive, criticism of the author's views.

DISCUSSION

The PRESIDENT, in opening the discussion, called upon Mr. Thomas Hayes (Clerk to the Governors of St. Bartholomew's Hospital), who asked permission for Miss C. K. Hayes, the Superintendent of the theatres at the hospital, to say a few words.

Miss C. K. HAYES emphasized the importance of a high standard of lighting in the operating theatre, which must, however, be combined with security against any danger of collections of dust, such as might fall on the table. Conditions of shadow were also of great importance. The surgeon desired to be able to see the face of the patient besides the part on which he was operating. Although the local light yielded by some forms of special lamps was good, they had found that it needed to be supplemented. Miss Hayes also stressed the necessity for greater constancy and precision in regard to light; there was, for example, too great a difference between natural and artificial conditions. It seemed, therefore, that this problem would not be really satisfactorily solved until the architect and the illuminating engineer could bring their joint experience to bear.

Mr. CHARLES M. POWER (Secretary, Westminster Hospital) stated that he had not come prepared to speak, but he wished, as an hospital officer, to thank Mr. Raphael for his very interesting and instructive paper. He was chiefly concerned with the cost of maintenance of the installation, which should be studied very closely. He did not know whether illuminating engineers had come to a decision in regard to the ideal conditions of lighting, but it was a fact that no two doctors had quite the same views in regard to the effect of light. It might seem, at first sight, somewhat harsh to omit anything conducive to the comfort of a patient on the ground of expense. One must, however, bear in mind that the life of a patient in an hospital was only about 21 days; therefore it was not necessary to study their comfort in such a way as to cause a substantial increase in the cost of maintenance; for example, if unduly elaborate fittings were used he shuddered to think of the price of replacements. His own impression was that, in general, the lighting was very satisfactory; this was doubtless due to the efforts of Mr. Raphael and his colleagues. They had found that some forms of lamps for operating tables were better than others: some difficulty had been experienced in regard to the heat, but this had now been remedied. He would like to hear Mr. Raphael's views as to the possibility of fitting movable joints to the wall brackets over the beds. It was difficult to get the light in a convenient position both for the patients and for the surgeon. Had the universal movable joint been tried? In conclusion, he wished again to thank Mr. Raphael for his interesting paper—a most helpful one to hospital officers.

Mr. HAROLD BRIGHT remarked on the relatively low expenditure on light at St. Bartholomew's, where, he believed, there were about 700 beds. He would like to know what steps had been taken to prevent waste and to keep the expenditure so low. In regard to ward lighting, he observed that Mr. Raphael seemed to be content with the provision of only one 40-watt lamp, placed over the sister's table for night-lighting. He rather wondered whether this could give sufficient light without causing some degree of glare. He contrasted this arrangement with the system at the Metropolitan Hospital, where they used a row of pendants down the centre of the ward. Some of these were equipped with conical shades round lamps of low candle-power so that the light was just sufficient to reveal the space between the beds at night and enable the nurse to see her way about.

Another innovation which he thought would give rise to economies at this hospital was the arrangement of the staircase and passage lights. These should be operated from two separate distribution boards with a master switch in the porter's lodge—an arrangement which saved wastage, as the lights could not be switched on and inadvertently left burning when no longer needed. This system had been in use for several months, and had been found very satisfactory. In regard to the scialytic type of light he had met with the criticism that there was a risk, when pulling this up and down, of dislodging accumulated dust. Did Mr. Raphael think that the old method of a ring of lights had any advantage in this respect?

Mr. Ernest Stroud recalled that Mr. Raphael in his paper had invited him to give his experience with the general lighting of a theatre by means of prismatic glass plates. He had therefore come prepared to do so. The best way to light an operating theatre was by laylights, this avoiding hanging pendants. With the system described one could get a very intense beam over a large area, and owing to the inclination of the rays there was no glare. The beams converged on the centre of the table, and the light was shadowless. They had experienced no difficulty with these prismatic panels, but if any objection was taken to the rough surface this could easily be met by using glass with a smooth exterior surface.

(Mr. Stroud illustrated his remarks by a series of slides showing the manner in which the beams from individual prismatic panel units could be combined, and by diagrams showing the polar curve of light-distribution of the whole arrangement.)

He would like to say one or two words about the paper in general. In such a case as this the running cost should always remain in the mind of the illuminating engineer. They must provide adequate light at a reasonable cost. He himself thought that semi-indirect lighting, with a type of unit that was easy to clean, was a satisfactory method of lighting wards. He, too, wished to thank Mr. Raphael for his paper, and hoped to learn from the discussion.

Mr. H. C. Wheat, who also expressed appreciation of the paper, remarked that Mr. Raphael had a great advantage in being in touch with the hospital staff and with architects concerned with this problem. He was continually conscious of the difficulties arising from imperfect contact in such cases as this, and he could well appreciate the fact that opinions of doctors in regard to lighting differed considerably. There was just one point in Mr. Raphael's paper that he would like to mention, namely, the effect of contrast between the brightness of the walls and of the operating table. Mr. Raphael had shown several interesting slides comparing effects with different colours of walls and towels. He thought this illustrated the point that it was really the actual surface brightness with which one was concerned rather than the intensity of illumination.

Mr. H. E. Mathews, F.R.I.B.A., said that there were one or two points in the paper of special interest to him—particularly the slide illustrating the results at St. Bartholomew's in the operating theatre with the white and green walls. The photograph was quite conclusive in illustrating the effect of the change of colour. He had no idea that the difference was so great. Nevertheless it was important that surgeons should have a restful background for their work, and from this standpoint bright surroundings were not expedient. In regard to Mr. Raphael's remarks on treating the walls of the ward with matt-surface paint, he might mention that in the hospital with which he (Mr. Mathews) was familiar they did not use matt but glossy paint; this would make some difference in the reading. He had one grievance against the form of shade which Mr. Raphael had illustrated—there seemed to be a possible "dust-trap" at the bottom. The scialytic type of light should receive further consideration from illuminating engineers. The one great drawback of this form of light was the collection of dust, which he had seen in evidence even during an operation. Another possible source of trouble was the working of the pulleys; the wires were somewhat liable to break, and in some cases the pulleys would not act. It was therefore necessary to have the casings removed periodically in order to ensure that the moving parts functioned properly. He wished to express his appreciation of the great care exercised by the author in the preparation of his paper and of the useful information it contained.

Mr. J. S. Dow said that there were two points he wished to raise. He thought that they had not been completely covered in Mr. Raphael's admirable paper. The first point was the lighting of the ward. He had occasionally heard people claim that indirect lighting was the best system because all sources were screened, and there was no glare. He himself was rather an enthusiast on indirect lighting in offices. In such circumstances the soft shadows and avoidance of reflected glare from paper were valuable features; but he was not at all sure that the method was equally good in a hospital ward: it was not expedient that patients in bed should look up at an illuminated ceiling, even if the ceiling was of a low brightness. He was therefore inclined to think that well-shaded direct lighting, giving a subdued brightness of surroundings, was preferable. His second point related to the intensity of illumination on operating tables. It was agreed that it was of vital importance to have fittings which did not harbour dust, and that it was desirable to have a comparatively shadowless light. But there seemed less certainty in regard to the illumination required. He recalled an incident in the United States when, owing to the taking of a film in an operating theatre, they had to use an exceptionally high illlumination of 1,500 foot-candles. The surgeon (it was reported) found this high value so excellent, and ever after he insisted on this high illumination! On the other hand, he (Mr. Dow) had been told that it was frequently impossible (owing to the presence of blood) to see the essential place, and that a great deal had to be done by touch, so that a very high illumination was not such a great advantage. One would like to have a standard in such a definite case as the lighting of operating tables—at present some people desired thousands of foot-candles whilst others were content with 100 or less.

Mr. G. Davidson, referring to comments on the scialytic light, pointed out that any fitting hung from the ceiling—no matter of what size or shape—might harbour dust. The best thing one could do was to make fittings of such a shape and of such materials as to be easily cleanable, and with no holes or small projections to gather the dust. It was difficult to get unanimity of opinion from surgeons on any detailed points in lighting—so much depended on the individual. Shadowless lighting, however, had proved its value, though no doubt the ideal fitting had still to be invented.

Mr. E. W. Johnston (Chief Engineer, King's College Hospital) remarked that in lighting wards one must attain a certain standard of efficiency; the two facts to be borne in mind were to keep the light out of the patient's eyes, and to ensure ease of cleaning. The beds in his hospital were provided with brackets similar to those shown by the author, and fitted with plain opal shades. These had been found quite satisfactory as far as the illumination on the

bed is concerned, but they were in the direct vision of the patients opposite. He had tried to improve on this condition, but his production had been considered difficult to clean. He was interested in the scialytic light for operating theatres. In his opinion it had come to stay, and from the point of view of illumination it answered requirements. There was just one point he might mention—the light must not give off so much heat as to affect the surgeon. In any circumstance a surgeon worked under onerous conditions. Anything that could be done to make his task lighter should be done. The scialytic light helped him greatly, but there was one other objection, namely, the possibility of the dust dropping on to the patient. In his hospital they had a large reflector fixed with an arm to raise and lower with ball fittings. This required no ceiling suspension, and was easily cleaned. They were still awaiting a device yielding adequate and shadowless illumination, but capable of being mounted on an adjustable arm on the wall.

Mr. T. LUDGATE said that lighting arrangements were often affected by the curious positions assigned to beds in wards. Sometimes lighting of the beds might be all right for the patients but inadequate for the surgeon. A special adjustable lamp should be provided for his benefit. In regard to the dimming of lights at night, why have lights at night? The patients don't want them, and the sister in charge can use the overhead lights to see her way about. He recalled a system of subdued lighting with colour-sprayed lamps which had proved satisfactory. The sister could see all over the ward, and the patients could not see the actual source of light. Emergency control must be provided to guard against failure of the main supply; but what about the failure of the filaments? Emergency lighting was very expensive. In one case the trouble was overcome by putting in a special light-panel, so that in the event of the scialytic lamp failing the surgeon could still go on with his work.

The PRESIDENT remarked that it was not quite accurate to say that the scialytic form of lamp was "shadowless"; it merely prevented a shadow from the operator's head. He recalled the case of a large county hospital where they were not satisfied with the lighting of the operating table and had sought his advice. The two leading surgeons and the matron all disliked overhead units because of the dust. He himself agreed with their view. In such circumstances it was more difficult than most people imagined to prevent deposits of dust. He had therefore suggested the old method of ring-lights, but consisting of perfectly smooth small enclosed fittings similar to those used on motor-cars for spot-lights. There were no chains nor pulleys. The lights were supported by simple plain tubes, and the angle at which the light was directed on to the operating table could be varied.

In regard to precautions against the failure of lights, he advised the method of using 12-25 volt lamps supplied from a transformer, or operated from batteries of the car type on charge for certain times of the day. Naturally one did not use the whole outfit at once. When one section failed one could use the other. This method answered requirements very successfully. He wished to conclude his remarks by moving a cordial vote of thanks to Mr. Raphael for his very interesting and instructive paper.

Mr. F. CHARLES RAPHAEL, in his reply, which, as promised, he has now extended, said that he would begin by dispelling the fears of several speakers that dust constituted a danger in a hospital operating theatre. When he had first to put in lights for an operating table he was himself opposed in principle to placing an adjustable fitting over the table; nevertheless it was clear that a shadowless lamp was so important that one must sacrifice a little of one's theory in order to have its advantages. In practice, the question is disposed of very simply by the mere fact that there *is* no dust. Everything is cleaned and sterilized when the theatre is prepared for an operation; there is no dust left to fall, and no dust is introduced during the operation. It is merely necessary to ensure that the shape of the surfaces upon which dust might collect is such that the dust can be easily cleaned off.

In the ward it is equally necessary that the surfaces upon which dust may collect are shaped so that they can easily be cleaned, but it has to be remembered that dust can be introduced into the ward more easily throughout the day, and that the ward is continuously occupied by patients. Consequently it is not advisable to have adjustable fittings over the beds, as any dust that may collect on them might be shaken off. Sharp angles should be avoided in design, and there should be no slightly concave surfaces on the top of fittings, as dust collecting there can be redistributed again by draughts. On the other hand, there is an advantage rather than a disadvantage in a dust trap which traps the dust in such a way that it cannot be automatically redistributed, and which it is easy and an obvious matter of routine to clean out, such as the slightly inwardly cupped surface of the hospital pattern shades illustrated in the paper and referred to by Mr. Mathews, although the actual reason of this cupping was to give a perfectly rounded surface instead of an edge at the bottom of the shade.

In reply to the various remarks as to the actual lighting of the operating table, one object of the paper was to show what values of illumination were satisfactory to the surgeons. Within cavities there was naturally a falling-off in illumination, and although it would be an ideal condition that the scialytic or other shadowless lamp should give sufficient light for all purposes, if this were increased unduly to light up deep cavities the disturbing effect of the higher surface brightness adjacent to the cavity would counterbalance the gain. At the Great Ormond Street Hospital for Children, it was found that the scialytic lamp illuminated the cavities sufficiently, but for really deep cavities a more closely localized and easily directed spot light would seem to be a necessity.

Miss Hayes' remarks made it clear that consideration of the general illumination of the theatre must not be allowed to fall into the background, and supported the view that some form of panel lighting as was suggested in Fig. 16 of the paper is desirable. It does not seem at all improbable that eventually surgeons will prefer to exclude daylight and operate by artificial light so as always to work under the same conditions. Meantime, the practice is growing of turning on the shadowless lamp over the table for daylight operations, to counteract the effect of the surface brilliancy of the walls.

Continuing, Mr. Raphael said that he attached great importance to Mr. Power's remarks on the question of maintenance. One could not have expensive fittings, and, moreover, some of the proposals that had been put forward would cause a great deal of trouble and expense in maintenance. He was glad to hear from Mr. Harold Bright that, in comparison with other hospitals, and taking account

of the number of beds, the cost of electric lighting at St. Bartholomew's Hospital was low—notwithstanding that the price per unit in the City of London was certainly not low. Ward lighting was not the only thing to be considered from the financial side, and to arrive at economical results one had to enter into every detail in every part of a hospital. He observed that Mr. Power did not believe in making extravagant arrangements for the comfort of patients. It was, however, possible to furnish cheerful lighting without putting up the wattage; general high illumination was apt to give a flat effect. Cheerfulness and variety was desirable; it had even been argued that wireless tended to diminish the time spent by a patient in the hospital.

Ball sockets or fittings with movable joints had been suggested for the bed lights. In addition to the dust question, already referred to, maintenance cost had again to be considered here. Such things increase maintenance cost enormously, and the difference between one universal ball socket per ward and twenty might involve the wages of an additional maintenance wireman in a large hospital.

Mr. Bright had raised the question of glare from the night lights. There was no glare from the green and white opal shade, and it gave the subdued light desirable in the wards.

He was glad that Mr. Stroud could cover up the crinkly surface of his prismatic panels to prevent collection on surfaces out of reach for dusting by the nursing staff, but the chief disadvantages of Mr. Stroud's system of operating-theatre lighting was high initial cost. Mr. Mathews had referred to the cream and green walls, and he (Mr. Raphael) was glad that he had convinced at least one architect on this point.

It was satisfactory to receive confirmation from Mr. Dow that high ceiling brightness was undesirable for ward lighting. He could assure Mr. Johnston that there was no need to retain the out-of-date opal shade for bed brackets and submit to the glare experienced by the beds facing them. The shade described in the paper was identified in Mr. Raphael's specifications as No. 4, and not only this one but the three previous patterns were easy to clean and caused no glare.

Literature on Lighting

(Abstracts of recent articles on Illumination and Photometry in the Technical Press)

Abstracts are classified under the following headings: I, Radiation and General Physics; II, Photometry; III, Sources of Light; IV, Lighting Equipment; V, Applications of Light; VI, Miscellaneous. The following, whose initials appear under the items for which they were responsible, have already assisted in the compilation of abstracts: Miss E. S. Barclay-Smith, Mr. W. Barnett, Mr. S. S. Beggs, Mr. F. J. C. Brookes, Mr. H. Buckley, Mr. L. J. Collier, Mr. H. M. Cotterill, Mr. J. S. Dow, Mr. J. Eck, Dr. S. English, Dr. T. H. Harrison, Mr. C. A. Morton, Mr. G. S. Robinson, Mr. W. R. Stevens, Mr. J. M. Waldram, Mr. W. C. M. Whittle, and Mr. G. H. Wilson. Abstracts cover the month preceding the date of publication. When desired by readers we will gladly endeavour to obtain copies of journals containing any articles abstracted and will supply them at cost.—ED.

(*Continued from p.* 102, *April*, 1933.)

I.—RADIATION AND GENERAL PHYSICS.

109. A Proposed Scale for Use in Specifying the Chromaticity of Incandescent Illuminants and Various Phases of Daylight. Irwin G. Priest.

Journ. Opt. Soc. Am., 23, *pp.* 41-45, 1933.

It is proposed that instead of specifying the colour of black and grey bodies in terms of "colour temperature," the colour of such sources should be expressed in micro-units of the reciprocal of the colour temperature. The expression of the colour of such sources in such units would be called the "chromaticity." Thus the chromaticity of an electric lamp running at a colour temperature of 2000° K. would be $\frac{1}{2000} \times 10 = 500$. The advantages claimed by introducing such a unit are: (1) The smallest perceptible change of chromaticity is almost constant, i.e., independent of the absolute value of the chromaticity. (2) The unit of chromaticity is of a convenient size for calculation. (3) For many calculations (e.g., in using Planck's Law) "chromaticity" would be more easily handled than "colour temperature." (4) This new unit would be more closely related to colour and further removed from the rather irrelevant conception of temperature. T. H. H.

110. Measurement of Ultra-violet Solar Radiation in Various Localities. W. W. Coblentz, R. Stair and J. M. Hogue.

Bureau of Standards Journal of Research, Vol. 10, *No.* 1, *p.* 79, *January*, 1933.

The paper contains a description of the calibration of a selective photo-chemical, ultra-violet dosage intensity meter against a balanced thermo-couple and filter ratiometer, used as a standard. Data are given of the ultra-violet intensities of solar radiation in various localities at various elevations at various stations in Europe and upon the ocean. W. B.

111. Colour Filters for Altering Colour Temperature. Pyrometer Absorption and Daylight Glasses. H. P. Gage.

Journ. Opt. Soc. Am., 23, *pp.* 46-54, 1933.

This paper deals with the theoretical spectral transmission of filters which are designed for the purpose of lowering or raising the apparent colour temperature of black and grey body sources of light.

The Wien equation shows that a filter whose density (δ) ($\delta = \log_{10}$ transmission) is given by $\delta = (6223/\lambda^{\frac{(1-1)}{\theta_1 \theta_2}}$, where λ is wavelength in microns, will reduce the colour temperature of a black body at an absolute temperature of θ_1 to that of a black body at a lower temperature θ_2.

A similar type of formula for the transmissive index of filters designed to increase the apparent colour temperatures of black and grey body sources is also given. It is pointed out that for a kind of filter whose transmittance as a function of the frequency of the light obeys this formula, the change in the reciprocal of the temperature is proportional to the thickness of the glass used in the filter. T. H. H.

II.—PHOTOMETRY.

112. Recent Improvements in Photo-electric Cells. Normal R. Campbell.

Journal of Scientific Instruments, Vol. IX, No. 12, *p.* 369, *December*, 1932.

The article is divided into three sections dealing with rectifier cells, emission cells and conductive cells. The description of the rectifier type is accompanied by a curve showing the general form of the voltage-current characteristic for different illuminations. It is pointed out that rectifier cells are not well suited for accurate measurement, for detecting very small quantities of radiation, or for any purpose requiring valve amplification of the photo-

electric current. Nevertheless they have a wide field of use, namely, rough measurements of not less than 1/100 lumen. In this field lies commercial lamp photometers when errors of 1 or 2 per cent. are permissible, portable illumination photometers, and relays for galvanometers. By a fortunate chance the curve for the "Vorderwand" cuprous oxide cell approximates to the visibility curve more nearly than that of any unscreened emission cell. References covering each of the three types of cell are given. W. B.

113. Note on the Weston Photronic Photo-electric Cell. B. P. Romain.

Rev. Sc. Insts., Vol. 3, No. 2, pp. 83-85 February, 1933.

Experimental data are presented which show that the internal leakage path in the photronic cell may be regarded as consisting of three conductances which are: (1) a conductance which is constant for a given cell; (2) a conductance which is directly proportional to the illumination of the cell; (3) a conductance which is directly proportional to the total leakage current in the cell. F. J. C. B.

114. Photo-electric Cells: Their Properties and Uses. L. G. Stoodley.

World Power, 19, pp. 207-209, April, 1933.

The first instalment of an article dealing in some detail with the characteristics of both vacuum and gasfilled photo-electric cells. C. A. M.

III.—SOURCES OF LIGHT.

115. Developments in Electric Industry during 1932.

G.E. Review, Vol. 36, No. 1, p. 67, January, 1933.

Five new types of lamps are described: the Bi-Post construction for heavy-current lamps, the Bi-Plane projection lamp having two staggered flat-grid filaments, a pyrometer lamp, the photo-flood lamp for amateur cinematography, and a new three-filament headlight lamp. Developments in traffic control and airport lighting are also recorded. J. M. W.

116. Characteristic Equations of Vacuum and Gas-filled Tungsten-filament Lamps. L. E. Barrow and J. Franklyn Meyer.

Bureau of Standards Journal of Research, Vol. 9, No. 6, p. 721, December, 1933.

The manufacture of tungsten-filament incandescent lamps has changed very rapidly during recent years, and methods of lamp photometry have necessarily changed with the changes in the lamps. Photo-electric measurements have passed very largely from a mean horizontal candle-power basis to a lumen basis. The tables of characteristic relations of vacuum lamps, published in 1914 and based on measurements of horizontal candle-power, are no longer adequate for the newer types and larger sizes of lamps. Logarithmic equations of the second degree are shown to apply to vacuum lamps and to gasfilled lamps in three steps. The equations describe the characteristics of miniature lamps as well as large lamps. Tables of characteristic relations based on normal efficiencies of 10.0, 12.5 and 16.0 lumens per watt, computed by means of the characteristic equations, furnish means for ready calculation of light-output, current, power-input and operating efficiency over a range of voltages from 55 per cent. of normal voltage for vacuum lamps and 80 per cent. of normal voltage for gasfilled lamps, to 120 per cent. of normal voltage for all types and sizes up to 150 watts, and to 132 per cent. of normal voltage for large gasfilled lamps, sizes 200 watts and upwards. W. B.

117. Temperature and Resistance Measurements of Lamp Filaments. H. Pécheux.

L'Electricien, Vol. LXIV, No. 1,561, pp. 151-158, 1933.

Comparisons of temperature were made for carbon and tungsten filaments, using a photometric method with an amyl acetate flame and also an optical pyrometer, while the resistances were established by the usual electrical methods. Remarkable and characteristic results were obtained from which the "co-efficients of temperature" could be deduced. The photometric method, although of inferior accuracy compared to the pyrometric, is claimed by the results given to be adequate, far quicker and eminently suitable for practical work. J. E.

118. Electric Lamp Filaments.

Licht und Lampe, Vol. 22, No. 6, pp. 190-191, 1933.

To secure even coiling of the filament, and thus ensure regular temperature throughout, a new method of coiling is described. J. E.

119. New Researches on the Production of Light. M. Pirani.

Electrotechn. Zeits, 42, pp. 1001-1005, 1932.

This paper is a review of new types of electric-light sources utilizing the luminous discharge in gases. It is pointed out that the efficiency of the best sources using temperature radiation is only about 15 per cent. of that of the sun. A considerable increase in efficiency can be obtained by the use of suitably designed luminous-discharge tubes. At high pressures some metallic vapours give an almost continuous spectrum over part of the visible spectrum. The vapours which can be utilized include sodium, magnesium, cadmium, zinc, mercury, neon and helium. The mercury-vapour tube is especially useful when the vapour is at high pressure. In this case an efficiency of 50 lumens per watt is possible. Such a tube should be used in conjunction with a neon tube to compensate for the absence of red radiation. A specification is given for a sodium-vapour tube, with which it is possible to obtain an efficiency as high as 400 lumens per watt. L. J. C.

120. A Review of Gaseous Conduction Lamps. L. J. Buttolph.

Am. Illum. Eng. Soc., Trans., 28, pp. 153-182, February, 1933.

The paper first discusses the luminous characteristics of various gases used in lamps of the gaseous conduction type. Electrode design is dealt with fully, and information is given on the requirements for starting. Some data are given on efficiency, life and depreciation. G. H. W.

121. Mazda Sodium Lamp. Anon.

El. Times, 83, p. 352, March 16th, 1933.

A brief account with a drawing of a recently developed low-tension luminous tube. Both mercury and sodium-vapour types are available, the latter having an efficiency of about 50 lumens/watt and consuming 80 to 100 watts. W. R. S.

122. Two-way Asymmetrical Gas Lamp.

Gas Journal, Vol. 201, No.3645, p. 805.

A low-pressure gas lamp intended for street-lighting purposes giving a maximum emission, at from 70° to 80° from the vertical, using four "bijou" mantles on either side, and intended for mounting 14 ft. above ground with a spacing of 150 to 200 feet, is described with polar curve and measured illumination at various distances. J. E.

IV.—LIGHTING EQUIPMENT.

123. A Lighting Development. Anon.

El. Rev., 112, *p.* 530, *April 14th*, 1933.

A new type of silvered-glass reflector is described in which the glass is a blue filter, so that light emerging from the unit by reflection is deficient in the orange and yellow end of the spectrum. W. R. S.

124. Luminous Tube Signs. Capt. C. Higgins.

El. Times, 83, *p.* 280, *March 2nd*, 1933.

Gives a summary of a lecture which included an outline of the theory of operation, voltage-systems employed, power factor of the tubes and some recent developments. W. R. S.

125. Reinforced Concrete Standards. B. Dennison.

El. Rev., 112, *p.* 521, *April 14th*, 1933.

The article points out the superiority of concrete standards over the older type of tubular steel. The concrete standard can be made tall enough to serve simultaneously for highway lighting and trolley-wire suspension. Some photographs are given. W. R. S.

126. Reactor-Rectifier Circuits Serve as Flasher and Dimmer. C. G. Suits.

El. World, 101, *p.* 320, *March 11th*, 1933.

Describes a new method of flashing lamps in series, utilizing the saturable core reactor. Each lamp is in series with the secondary winding of a reactor, the primary of which is fed from the circuit of the previous lamp via a rectifier. The advantage claimed for this type of control is that there are no moving parts to wear, as in the case of the mechanical flasher. W. C. M. W.

127. Controlled Lighting. Anon.

Elec., 110, *p.* 436, *March 31st*, 1933.

Particulars are given of recent developments in various lighting fittings, including laylight equipment. C. A. M.

128. Light Emission from Fittings. Dr. Ing. W. Pohle.

Elektrotechnische Zeitschrift, *No.* 15, *pp.* 353-357, 1932.

The light-emission from fittings as illustrated by polar curves does not meet all practical requirerequirements. Two instruments, one for vertical and the other for horizontal analysis, are described and interesting results are summarized. J. E.

V.—APPLICATIONS OF LIGHT.

129. Light and Architecture.

Am. Illum. Eng. Soc., Trans., 28, *pp.* 111-120, *February*, 1933.

Illustrated descriptions of eight lighting installations planned on modern lines. G. H. W.

130. Two Contributions on Architectural Lighting. H. Bertling.

Licht. u. Lampe, 22, *No.* 6, *p.* 182, 1933.

(1) By the scientific use of clear-cut shadows and their illumination by different coloured lights new effects are obtained. Some examples are given of effects obtained by combining different coloured discharge tubes in this way. Varied effects may also be obtained by the use of selected paints on the illuminated surfaces. (2) A grid is arranged in front of several parallel discharge tubes of various colours, so that a changing colour effect is obtained as the angle of observation alters. E. S. B-S.

130. Lighting. Anon.

El. Rev., 112, *Special Supplement*, *March 17th*, 1933.

Contains advice and suggestions for improved lighting of ordinary homes, and some notes on the selling of home lighting equipment. Several photographs are included. W. R. S.

131. More on Home Makers' Attitude. Anon.

El. World, 101, *p.* 299, *March 4th*, 1933.

The results of a recent survey of homes are presented. Data are furnished illustrating the opinions expressed in regard to lighting by large numbers of persons in all social classes. W. C. M. W.

132. Relighting a Banking Room. R. A. Palmer.

El. World, 101, *pp.* 297-298, *March 4th*, 1933.

Describes the modernization of the lighting of the main floor banking room of the American Trust Co., Charlotte, N.C., U.S.A. The old type of direct-lighting fixtures were replaced by semi-indirect fittings, whilst single 300-watt lamps were substituted for the old clusters of six 40-watt lamps. The illumination of the working plane has increased from between 3 and 6 foot-candles to an average of 10 foot-candles. W. C. M. W.

133. Suitable Illumination for Sick Rooms. Anon.

Licht u. Lampe, 22, *No.* 8, *p.* 229, 1933.

A discussion of lighting fittings for sick rooms which are suitable both with regard to the sensitiveness of an invalid and the hygienic requirements of a hospital. E. S. B-S.

134. Accidents and Illumination. Dr. Ing. O. Schneider.

Licht und Lampe, *Vol.* 22, *No.* 6, *p.* 186, 1933.

The author points out the necessity of factory illumination being not only adequate for the machines and gangways, but also for calling attention to dangerous situations. He regrets the inadequacy of statistics showing the undoubted connection between accidents and inadequate illumination. J. E.

135. Underground Lighting in Mines. R. H. Campin.

Nature, *Vol.* 131, *No.* 3309, *p.* 465, *April 1st*, 1933.

Abstract of paper in "Mining Electrical Engineer," February, 1933. The paper deals with the importance of adequate lighting; the antiquated form of the lamps in use; and the improvements likely to be effected by increased illumination. Reference should be made to original paper. J. M. W.

136. Automatically-controlled Street Lighting. Anon.

Electronics, 6, *p.* 74, *March*, 1933.

Includes a brief account of a street-lighting installation which is controlled by a photo-electric cell. The lights are automatically switched on when the daylight illumination falls below 1½ foot-candles. W. R. S.

137. Gas-lighted Refuges for Pedestrians.

Gas World, *Vol. XCVII*, *No.* 2521, *p.* 519, 1933.

The method of carrying out the ground and pillar type illumination of street islands with caution signals as used in Paris is described and illustrated. about 250 of such lanterns are now in operation, each consuming from 10,940 to 13,769 cub. ft. of gas annually. J. E.

"—use only"

Director: "What *is* the matter with our electric light these days? We seem to have less light and to pay more for current than ever before."

Manager: "I'm afraid we made the mistake of installing 'cheap' lamps at the beginning of the winter. They lose light very quickly and replacements have been unduly heavy. We shall not make the same mistake again, but in future will use only

MAZDA LAMPS

WITH THE WONDERFUL NON-SAG FILAMENT.

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MADE IN ENGLAND ENTIRELY FROM BRITISH MATERIALS.

THE BRITISH THOMSON-HOUSTON COMPANY, LTD.

138. Developments in Highway Research. Anon.

Nature, Vol. 131, *No.* 3305, *p.* 334.

Abstract of a radio talk on research directed to safety in highways in America. Some data of desirable characteristics for road signs is given.

J. M. W.

139. Outdoor Sub-station Illumination. H. E. Hutter.

El. Times, 83, *p.* 345, *March 16th*, 1933.

The continuation of a paper which appeared on December 1st. The present instalment gives notes on detailed designs and includes photographs of existing installations. W. R. S.

140. Floodlighting of Public Buildings. F. D. Crowther.

G.E. Review, Vol. 35, *No.* 12, *p.* 639, December, 1932.

A discussion of the general principles of floodlighting by conventional apparatus. J. M.W.

141. Illuminated Fountains. Anon.

Nature, Vol. 131, *No.* 3305, *p.* 302, *March 4th*, 1933.

Brief note describing an illuminated fountain constructed in the Lake of Zurich for a "Lighting Week." It consisted of a large pontoon of circular shape, 10 m. diameter, containing five pump sets, each capable of delivering 220 lbs. of water per second under a head of 20 m. 1,000- and 1,500-watt projectors in watertight concrete cases were used to illustrate the jets. (See *Escher Wyss. News*, October, 1932.) J. M. W.

142. Electricity in Australia. Anon.

Elect., 110, *pp.* 351-352, *March 17th*, 1933.

An interesting instance of outdoor illumination is the floodlighting of three great rocks in the Blue Mountains (N.S.W.), across a chasm 1,800 ft. deep and half a mile wide. A photograph is given.

C. A. M.

143. Show-window Illumination as a Problem of the Shape of the Window. E. Meyer.

Licht u. Lampe, 22, *No.* 8, *p.* 227, 1933.

Calculations are given of the best shapes for a show window with one side only, and with artificial lighting. With daylight the conditions are absolutely different, and a compromise must be reached.

E. S. B-S.

144. Electricity in the Theatre. F. G. H. Macras.

El. Rev., 112, *p.* 266, *February 24th*, 1933.

A brief outline of modern lighting practice in the theatre. The principle of the reactance dimmer is also explained. W. R. S.

145. Interior Lighting. R. W. Maitland.

Elect., 110, *p.* 466, *April 7th*, 1933

The paper is in the form of a detailed discussion of the problems that arise in the lighting of the interiors of theatres and cinemas. C. A. M.

146. Novel Lighting in Paris Cinema. Anon.

El. World, 101, *p.* 352, *March 18th*, 1933.

Lighting effects of an unusual nature are produced during intermissions in a Parisian cinema by draping the side walls with thin silk curtains which are made to shimmer and undulate, whilst changing coloured light falls upon them. Just before the commencement of the performance, panorama appropriate to the film to follow are projected to the side and proscenium curtains. W. C. M. W.

147. Neon Lighting at a Cinema. Anon.

El. Rev., 112, *p.* 462, *March 31st*, 1933.

A photograph and some details are given of an excellent example of neon display lighting on the front of the Elephant and Castle Cinema, London.

W. R. S.

148. Colour Lighting at Casani's Club. Anon.

El. Rev., 112, *p.* 534, *April 14th*, 1933.

Interesting photographs are given of Casani's Club, London, where the artificial lighting is said to be both unusual and effective. W. R. S.

149. Novel Lighting in Pittsburgh Night Club. Anon.

El. World, 101, *p.* 383, *March 25th*, 1933.

Gives a brief description of one of the rooms in the William Penn Hotel, a recently re-decorated night club in Pittsburgh, U.S.A. A noteworthy innovation in the use of spotlights, equipped with colour wheels, fitted below glass plates in the dance floor. W. C. M. W.

150. Cost of Neglected Maintenance. S. G. Hibben.

El. World, 101, *pp.* 332-334, *March 11th*, 1933.

Discusses the effects of neglecting to maintain installations and advocates more frequent cleaning and attention to lighting fittings. The author describes several methods of cleaning fittings and interior surfaces. W. C. M. W.

151. Visibility of Objects Illuminated by Searchlights. Part II. Yves Rocard.

Rev. d'Optique, Vol. 11, *No.* 11, *p.* 440. (*See also Nos.* 5 *and* 6-7, *pp.* 193 *and* 257.)

In the first part of this work, after the statement of the problem, all the mathematical elements have been given for the calculation of the brightnesses resulting from scattering which take place in the formation of contrast. In the second part definite cases of visibility have been worked out. Secondly, general interpretation has been made of certain experiments on the range of projectors from which the relation can be deduced between the brightness of the background, the contrast exhibited by the object, and the angle at which it is observed, which relation will always be satisfied at the limit of visibility. Finally, in the third part, this relation will be used to predict the performance of projectors approximating to the usual types, according to the atmospheric transmission and various other conditions. J. M. W.

152. The Use of Ultra-violet Sources for the General Illumination of Interiors. A. B. Oday and L. C. Porter.

Am. Illum Eng. Soc., Trans., 28, *pp.* 121-143, *February*, 1933.

The characteristics of S-1 and S-2 Sunlight lamps are given, together with the light and ultra-violet distribution curves of a typical dual-purpose lighting unit. The desirable dosage of ultra-violet for various classes of interior is discussed, and particulars are given of types of installation using various proportions of visible light to ultra-violet.

G. H. W.

153. A New Dark Field Microscope Illuminator for Opaque Objects. John J. Gerlach, Jr.

Rev. Sc. Insts., 2, *pp.* 412-415, *July*, 1931.

The fundamental part of the illuminating system is an annular prism surrounding the object. Diffused light from below is refracted by the prism and falls obliquely and uniformly on all sides of the object.

F. J. C. B.

New Electricity Showrooms, Corporation Electricity Department, Ferensway, Hull

The lighting of the fine new showrooms of the Hull Corporation Electricity Department, on Ferensway, includes many model features, notably the three-colour lighting in the dome ceiling of the main hall, four large laylights and several of the exterior display windows. The illumination of the dome (see Fig. 1) is provided by approximately 100 ft. of special Holophane three-colour troughing, which is fitted with 170 60-watt clear lamps with special colour screens. Each of the four laylights is lighted by means of four 9-ft. sections of Holophane three-colour diffusing battens, fitted with 100-watt lamps, and so arranged that a white curved metal surface reflects the coloured lighting of many hues through the decorative glass of the laylight. Both the dome lighting and the laylight equipment is controlled by a motor-driven colour controller, which provides continuous and subtle changes of colour in the hall. This controller can be stopped at any position, and it is possible to obtain many magnificent colour tones on the dome ceiling.

The exterior display windows are fitted with three-colour shop-window type battens and footlights, which are controlled by a motor-driven colour controller separate and distinct from that provided for the main hall lighting.

Holophane " Hedralite " fittings of various types have been provided for the main staircases and other parts of the building, and a new type of Holophane prismatic reflecting plate has been provided for the white lighting of several of the showroom windows; these plates provide excellent lighting for the windows, and have been mounted at a comparatively low level without any suggestion of glare.

The main Ferensway entrance lobby is lighted in a novel manner by means of a large laylight of solid copper measuring some 13 ft. in length, and glazed with prismatic plates arranged in a formation to show the letters H.C.E. (Hull Corporation Electricity). A framework immediately above the laylight carries a large number of prismatic reflectors. A small alcove facing the interior of the showrooms has been fitted with an extremely attractive Holophane scenic display—a delightful panorama of distant country with an urned balustrade covered with flowering creepers in the foreground, and a miniature water-fountain and pool. (See Fig. 2.)

The display is lighted from above with Holophane colour battens to suggest a sunset. The display is seen through a glass panel, and will undoubtedly be one of the chief attractions in the showroom. Additional lighting for the main dome is obtained from a Holophane pedestal unit which illuminates the dome with a rich golden glow, whilst showing panels of deep violet to contrast with the golden glow emitted from the top of the pedestal.

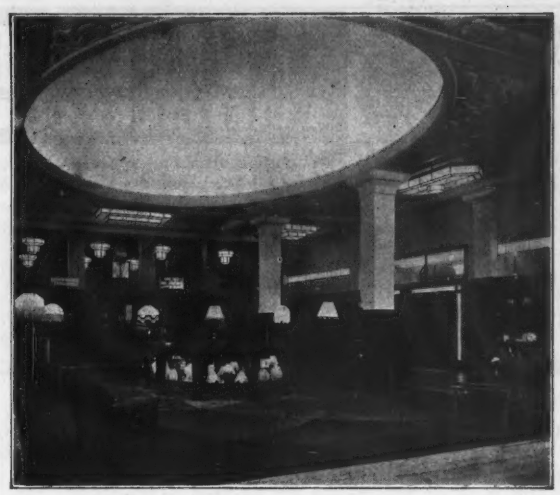
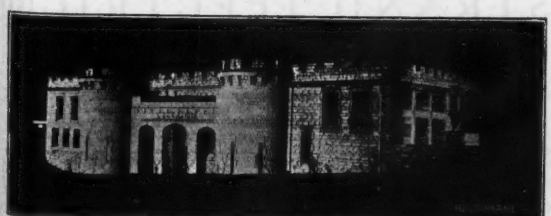


FIG. 1.—A view of the Main Hall, showing the fine Dome Ceiling.



Sun Castle, Skegness, floodlighted with 500-watt projectors. Another interesting Holophane installation.

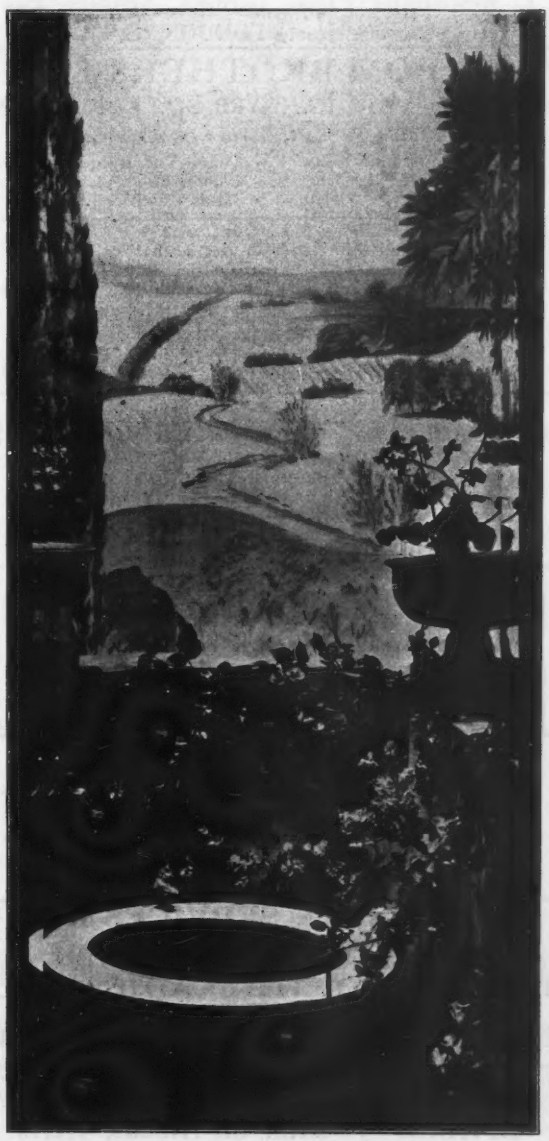
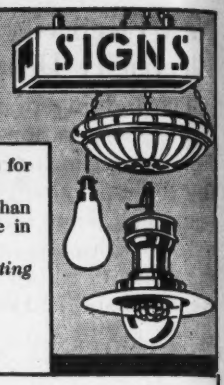


FIG. 2.—A pleasing Alcove facing the Interior of the Showrooms, revealing a landscape with concealed lighting.

WHERE TO BUY
A DIRECTORY OF LIGHTING EQUIPMENT



We invite applications for spaces in this new section of the journal. Particulars of terms for each space (approx. 1 inch deep and 3¼ inches wide) are given below.

These terms are equivalent to **half our ordinary advertising rates**, but not less than 12 successive monthly insertions can be accepted on this basis, and amounts are payable in advance.

Payment for an advertisement in this section entitles the advertiser to receive *The Illuminating Engineer* during the period of the contract.

Terms :	12 Successive Monthly Insertions	£3	10	0	Payable in Advance
	24 " " "	£6	0	0	
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(1)

MODERN LIGHTING FITTINGS

New Catalogue on application

Fittings manufactured to Architects' Specifications

ASCOG LIMITED

Ascog House, 44, Theobalds Road, LONDON, W.C.1

(2)

PHOTOMETERS

ALEXANDER WRIGHT & CO., LTD.,

1, Westminster Palace Gardens, Artillery Row, Victoria Street, LONDON, S.W.1.

(3)

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Specialists in the Science of Modern Lighting, including :—

Theatres and Public Halls. Tennis and Racquet Courts.
Pictures and Picture Galleries. Floodlighting, etc.
Decorative Fittings in Glass and Metal.

(4)

You get the benefit of over twenty years' world-wide experience in the science of Commercial and Industrial Illumination when you specify lighting planned by

BENJAMIN

The Benjamin Electric Ltd., Tottenham, N.17

(5)

"LINOLITE" STRIP REFLECTORS

For showcase, shopwindows, cornice, facia, architectural lighting, etc.

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Seamless Steel Lighting Standards. Traffic Signals. Guard Pillars

for all requirements

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ARCHITECTURAL ILLUMINATION AND DESIGNS

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ELECTRICITY SERVICES LTD.

Electrical Engineers

Sole Proprietors and Patentees of

THE "TYPERLITE" ADJUSTABLE LOCAL LIGHTING UNITS

Write for Price Lists : **86, CANNON ST., LONDON, E.C.4**

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Engineering & Lighting Equipment Co. Ltd.

SPHERE WORKS, St. Albans, Herts.

Manufacturers of :—

Street and Industrial Lighting Fitttings and Equipment.

Specialists for over 30 years. Send for new Cat. No. 12.

(10)

"ESLA"

BI-MULTI AND MULTIPLANE REFLECTORS

Lanterns, Brackets, Columns, Switch and Fuse Boxes etc., **FOR STREET LIGHTING**

The Electric Street Lighting Apparatus Co. The Foundry, Canterbury

(11)

G.V.D. ILLUMINATORS

Controlled Diffusion and Distribution of Light.

Industrial and Architectural Lighting.

Aldwych House, LONDON, W.C.2.

(12)

HAILWOOD & ACKROYD LTD.

BEACON WORKS, MORLEY, Near LEEDS

Sole makers of "HAILWARE" British-made Illuminating Glassware and Fittings, Traffic Globes and Signs, Island Columns and Footlights.

Offices and Showrooms at :—

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(13)

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HOLOPHANE

(*Scientific Illumination*)

ELVERTON ST., LONDON, S.W.

for

STREET CHURCH INDUSTRIAL
CINEMA FLOOD SCHOOL, Etc.

(14)

KANDEM ELECTRICAL LTD.

(Late KORTING & MATHIESEN ELECTRICAL LTD.)
711 and 715, FULHAM ROAD, LONDON, S.W.6

Scientifically designed Incandescent Lighting Equipment for **CHURCHES, SCHOOLS, FACTORIES, STORES, STREETS, FILM AND PHOTOGRAPHIC STUDIOS.**

Modern Arc Lamps for Street Lighting. Silent Arcs for Film and Photographic Studios.

(15)

RADIOVISOR PARENT LTD.

28, LITTLE RUSSELL STREET, LONDON, W.C.1

Specialists in Light Sensitive Work

AUTOMATIC CONTROL of STREET and FACTORY LIGHTING

Increasingly in demand as the most efficient and economical control

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SIEMENS

38-39, UPPER THAMES STREET, LONDON, E.C.4.

ELECTRIC LAMPS of all types. ELECTRIC LIGHT FITTINGS. FLOODLIGHTING APPARATUS. SHOP-WINDOW LIGHTING EQUIPMENT. STORE LIGHTING. INDUSTRIAL LIGHTING. CINEMA LIGHTING. ELECTRIC SIGNS, Etc.

(17)

STRAND ELECTRIC

AND ENGINEERING CO. LTD.

19-24, FLORAL STREET, LONDON, W.C.2

Specialists in Modern Theatrical Lighting

Manufacturers of "Sunray" Lighting Equipment
Electrical Installation Contractors. Lighting Schemes for
Theatres Floodlighting Exhibitions Cinemas Pageants
Shop Windows Dress Parades Ballrooms Tea Lounges

(18)

For every type of GAS LIGHTING

SUGG WESTMINSTER

When you want the best!

Chapter St., S.W.1

27th E.L.M.A. Illumination Design Conference

The Architects' Conference on Lighting having been carried through with success, the next item at the E.L.M.A. Lighting Service Bureau is the 27th Illumination Design Conference, which commences on May 15th. The value of this series of lectures is widely recognized. Previous conferences of the kind have invariably been well attended, and we understand that applications to attend the coming series have been coming in rapidly. Those who wish to be present, but have not yet sent in their names, are therefore advised to apply at once to the Manager (Mr. W. J. Jones) of the Lighting Service Bureau (2, Savoy Hill, London, W.C.2).

We reproduce below the complete syllabus of the lectures, which will evidently prove quite as varied and interesting as in previous years:—

MONDAY, MAY 15TH.

Morning.

9.30 Registration
10.0 Reception by the Chairman of the E.L.M.A. Council. W. F. Moir
10.15 How the Bureau is Helping the Electrical Industry. W. J. Jones
11.30 Lighting, Past, Present and Future R. C. Hawkins

Afternoon.

2.0 Illumination Terms and Relationships. T. Catten
3.0 Modern Shop-lighting Practice. F. Marsh
4.0 Selling Points and Characteristics of Electric Lamp Signs. H. Lingard

Evening.

Visits to Lighting Installations.

TUESDAY, MAY 16TH.

Morning.

9.45 The Fundamentals of Light Control. H. C. Wheat
10.45 Illumination Design Data. H. Lingard
11.30 Planning a Lighting Installation for a Factory. T. Catten

Afternoon.

2.0 The Production, Application and Effects of Coloured Light. R. O. Ackerley
3.0 The Fundamentals of Architectural Lighting. R. W. Maitland
4.0 Engineering Factors Underlying the Design of Built-in Lighting. W. J. Jones

WEDNESDAY, MAY 17TH

Morning.

9.45. The Characteristics of Electric Lamps. G. P. Dudding
10.45 Electric Light as a Factor in Industrial Efficiency. A. D. S. Atkinson
11.45 Extending the Lighting Service Idea. W. J. Jones

Afternoon.

2.0 Lighting Service Publicity. F. W. Benton
3.0 Facts and Figures Relating to Electric Street Lighting. E. B. Sawyer
4.0 New Ideas in Home Lighting:— The Views of a Specialist Miss D. M. Noakes
Practical Demonstrations in the Home Lighting Studio. Miss J. B. Kennedy

Evening.

Visits to Lighting Installations.

THURSDAY, MAY 18TH.

Morning.

9.45 Lighting for Outdoor and Indoor Sports. T. Machell
10.30 The Theory, Practice and Selling of Floodlighting. H. Lingard
11.40 Competition from Inefficient Lamps and What It Means to the Industry. C. A. Hughes

Afternoon.

2.30 Salesmanship. R. Brymer
3.45 General Discussion.

Evening.

Dinner as Guests of E.L.M.A. (Morning Dress).

FRIDAY, MAY 19TH.

Visits to Interesting Lighting Installations.

Architectural Lighting

A Handbook on Architectural Lighting (No. 8A) issued by the E.L.M.A. Lighting Service Bureau contains some useful practical hints, notably in connection with the spacing of lamps to avoid spotty effects and secure even brightness of diffusing-glass surfaces; tabular data are assembled in two diagrams relating respectively to "pearl" and opal lamps. Another table portrays the temperature rise in a channel forming part of a luminous doorway panel; the relative coolness of the ventilated (open back) design as compared with the unventilated (totally enclosed) form is evident—although even in the latter case it would seem that there is little risk of an approach to a dangerous temperature. The first portion of the book is illustrated by pleasing views of the architectural lighting room at the Lighting Service Bureau, whilst at the end of the booklet examples of architectural lighting in churches, hotels and restaurants, offices, public buildings, shops and showrooms, stations and theatres are given.

The Reflector

The March issue of "The Reflector," published by Benjamin Electric Ltd., is a bright and well-illustrated production. Amongst fittings featured is the "Duoflux" floodlighting projector, which appears to be proving specially acceptable for garage lighting. A letter from the Gipsy Corner Garage bears witness to their utility in enabling garages to be kept open all night. Numerous illustrations show the value of such floodlighting in attracting custom. Another feature is the account of the lighting of Nestle's factory at Battersea. Good examples of overhead lighting are shown. The same applies to the Ever Ready Works, another important Benjamin installation. In this instance one is struck by the successful photographs taken by artificial light with the workers all engaged on their jobs—a type of picture which would have been considered quite impracticable a few years ago.

G.E.C. Neon Aerodrome Beacon

A leaflet issued by the General Electric Co. Ltd. illustrates the neon aerodrome beacon, a coloured picture of which appears on the cover. The beacon consists of six hairpin-shaped neon tubes arranged round a tower in the form of a truncated cone, approximately 14 ft. high. Under favourable conditions the beacon can be seen from a distance of 50 miles, and the fact that it can be made to flash any Morse character, thus giving the name of the aerodrome, is a great advantage.

Simplex Electric Company Limited

Messrs. P. W. Davis and John Huntington, directors of Simplex Electric Co. Ltd., have been appointed joint general managers of the company. Messrs. E. A. Edwards and F. W. Martin have been elected to the Board, the former as sales director. Mr. H. F. McLoughlin has resigned the position of governing director.

Mr. Frederick Percy Driver

As we go to press we learn with great regret of the death of Mr. Frederick P. Driver, works manager of the P. Osram G.E.C. Works, who passed away on April 25th, after a brief illness. Mr. Driver had been associated with the Osram Works for many years. He was a member of the Illuminating Engineering Society of long standing.

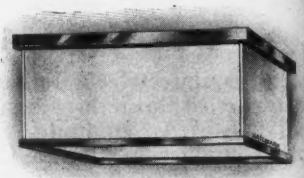
An Important Fusion of Interests

It is announced that a fusion of interests has taken place between David Allen Neon Displays Ltd. and Claude-General Neon Lights Ltd., the latter firm being, it is stated, the largest concern in its field in the United Kingdom. In future, the whole of the manufacture and erection work required for both undertakings will be carried out by Claude-General Neon Lights Ltd. from their Wembley factory. It is anticipated that substantial economies should in future be possible.

David Allen Neon Displays Ltd. is an offshoot of the advertising concern, David Allen & Sons Bill-posting Ltd., which will in future devote their energies to the development of the neon "site" business. It is believed that the next few years will show great progress in this field and substantially increased facilities for outdoor advertisers. Mr. S. C. F. Allen is joining the Board of Claude-General Neon Lights Ltd.

Hailware Fittings

We have received from Messrs. Hailwood & Ackroyd Ltd. several leaflets descriptive of new lines of illuminating glassware, notably H.W.35/4, which deals with pendant, wall and ceiling panel types of fittings, and G.W.85/15, which is devoted mainly to bowls, etc., in decorative colours. One is again struck my the variety of designs and the range of colouring, which is illustrated by the aid of colour-printing in the leaflets. Generally speaking, the



prices of these lines of glassware seem very moderate, and they are of entirely British manufacture, being made in the works of the company at Morley, near Leeds.

Contracts Closed

The following contracts are announced:—

THE EDISON SWAN ELECTRIC CO., LTD.:—

London and North-Eastern Railway; for a portion of their requirements of electric lamps for the 12 months commencing May 1st.

County Borough of Swansea; for a portion of their requirements of lamps for the 12 months from April 1st.

THE GENERAL ELECTRIC CO. LTD.:—

Borough of Aylesbury; for 12 months' requirements of Osram electric lamps.

Plympton St. Mary U.D.C.; for 12 months' supplies of Osram electric lamps.

County Borough of Swansea Electricity Department; for 12 months' requirements of Osram and Robertson electric lamps.

Whitby U.D.C.; for 12 months' supplies of Osram electric lamps.

Printed by Taylor Garnett Evans & Co. Ltd., Manchester and London.